

**Revised Environmental Assessment/Habitat Conservation Plan for Issuance of
Endangered Species Act Permits to Individual Lot Owners Under The Section 10(a)(1)(B)
Permit Numbers TE-025965-1-X (low; 4 subdivisions) and TE-025997-1-X (medium;
42 subdivisions) for the Incidental Take of the Endangered Houston Toad (*Bufo
houstonensis*) and Threatened Bald Eagle (*Haliaeetus leucocephalus*) During Construction
and Occupation of Single-Family Residences or other Similar Structures (each on
approximately 0.5 acres or less) in 46 Subdivisions in Bastrop County, Texas:**

Alum Creek Village	Pine Forest - Excluding Unit 6
Bastrop Cove Estates	Pine Forest - Unit 6
Bastrop Hills Homesites	Pine Hill Estates
Circle D Country Acres	Pine Junction
Cricket Hollow	Pine Oak Estates
Deer Trail	Pine Ridge Farms
Gravelly Oaks	Pine Tree Cattle Ranch
Green Acres	Pine Valley
Idle Acres	Pine View Estates
KC Estates	Pine Wood
Kee-El	Piney Ridge
Lake Bastrop Pines	Pioneer Pines Farm
Lake Thunderbird Estates	Ponderosa Homestead
Lake View Estates	Scenic Farms
Lincoln Lake Estates	Smithville West
Lost Pines	South Paige Estates
Lost Pines Park	Spring Hollow
Mesa Pinto	Tahitian Village
Milton Property	The Pinery
Ortiz Property	The Pines of Alum Creek
Overlook	Tonkawa Hills
Park Hill Farms	Turkey Run
Pine Cove Estates	Whispering Pines

U.S. Fish and Wildlife Service
10711 Burnet Road, Suite 200
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COVER SHEET

Title for Proposed Action: Revised Environmental Assessment/Habitat Conservation Plan for Issuance of Endangered Species Act Permits to Individual Lot Owners Under The Section 10(a)(1)(B) Permit Numbers TE-025965-1-X (low; 4 subdivisions) and TE-025997-1-X (medium; 42 subdivisions) for the Incidental Take of the Endangered Houston Toad (*Bufo houstonensis*) and Threatened Bald Eagle (*Haliaeetus leucocephalus*) During Construction and Occupation of Single-Family Residences or other Similar Structures (each on approximately 0.5 acres or less) in 46 Subdivisions in Bastrop County, Texas:

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Unit of U.S. Fish and Wildlife Service Proposing Action: Regional Director-Region 2, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Legal Mandate for Proposed Action: Endangered Species Act of 1973, as amended, Section 10(a)(1)(B), as implemented by 50 CFR 17.22

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1.0 INTRODUCTION

The U.S. Fish and Wildlife Service (Service) has amended the original 46-subdivision HCP to produce this Environmental Assessment/Habitat Conservation Plan (EA/HCP) to cover: (1) other structures similar to single-family residences; and (2) potential harassment of the threatened bald eagle (*Haliaeetus leucocephalus*). This amendment provides private landowners additional assurances that, should their activities result in harassment of the bald eagle, no additional mitigation would be required beyond the terms and conditions outlined in the original EA/HCP. The Service believes that the benefits of the EA/HCP outweigh any minimal impacts to the bald eagle that may occur.

This EA/HCP provides an efficient and effective option for landowners to obtain Endangered Species Act (Act) Section 10(a)(1)(B) incidental take permits (hereafter referred to in this document as “endangered species permit(s)”) for the construction and occupation of single-family residences or other similar structures on the remaining undeveloped lots in 46 specific subdivisions in Bastrop County, Texas. In addition to making the endangered species permitting process as efficient and effective as possible for private landowners, this EA/HCP has been developed in an effort to promote the long-term conservation of the endangered Houston toad (*Bufo houstonensis*), the bald eagle, and the Lost Pines ecosystem. These unique and irreplaceable natural resources are an important part of Bastrop County and our nation’s heritage. The Service anticipates this EA/HCP will facilitate development of, and within 5 years time be incorporated into, a Bastrop area “Lost Pines” HCP for Bastrop County, Texas.

Habitat protection efforts are needed for the long-term conservation of the Houston toad (listed as endangered in 1970; Critical Habitat designated in Bastrop and Burleson counties in 1978). Critical Habitat includes designated areas of land, water, and air space (43 FR 4022; 50 CFR 17.95). A small island of loblolly pine (*Pinus taeda*) forest in Bastrop County, known as the Lost Pines, supports Critical Habitat and the largest known remaining population of Houston toads throughout its limited range (Figures 1 and 2). The Houston toad faces intense and increasing pressure from real estate development. About 46% of the toad’s habitat in Bastrop County has already been cleared, platted, and/or partially developed, and development pressures are rapidly increasing. Bastrop County is the second-fastest growing county within the Texas Capital Area Planning Council region, with growth projections indicating the human population will triple over the next 30 years. This population increase and concomitant real estate activities are attributed to the proximity of the expanding Austin metropolitan area, the opening of the Austin-Bergstrom International Airport (located about 20 miles west of Bastrop), low land costs compared to Austin, and the aesthetic appeal of the Lost Pines. Bastrop State Park lies near the center of the Critical Habitat area and is an area of public land that supports a large number of Houston toads.

To address the accelerating human population expansion and to resolve conflicts between development and environmental concerns, the Bastrop County Commissioners’ Court

Figure 1: Nine counties in Texas where Houston toads occur (including Bastrop County)

Figure 2: Area that includes habitat for the endangered Houston toad in Bastrop County, Texas

unanimously passed a resolution in October, 1999, to proceed with “a County wide plan to protect the Houston toad and the quality of life for the citizens of Bastrop County consistent with the requirements of Federal and State law.” The Service and several community members have provided funds through a cooperative agreement to have the Texas Agricultural Extension Service assist the community in developing a Bastrop area HCP for Bastrop County (USFWS et al. 2000). The Service has been working to find financial, technical, and other resources needed to assist Bastrop County in protecting the Houston toad and the Lost Pines ecosystem upon which the toad depends. To promote community-based planning and local habitat protection efforts, the Service established the Houston Toad Conservation Fund with the National Fish and Wildlife Foundation (NFWF) in 1998 (USFWS and NFWF 1998). The primary purpose for establishing this Fund is to provide an avenue for payment of private or public funds to be used exclusively for conservation and recovery of the Houston toad and the habitats on which it depends. NFWF is a private, not-for-profit conservation organization established by Congress in 1984. While NFWF manages the Fund at the direction of the Service, the Service is not a recipient of any monies provided to the Fund, nor does it derive any benefit other than assisting local communities and the Texas Parks and Wildlife Department with conservation and recovery efforts by directing them to the Fund.

While awaiting a Bastrop area HCP, the Service continues to process many individual endangered species permits for development activities in Bastrop County. The rapid surge in real estate activity and increasing public awareness of endangered species issues in Bastrop County have resulted in an overwhelming number of single-family landowners inquiring about how to obtain endangered species permits and ensure their compliance with the Act.

To aid the traditional permitting process, where permit applicants are responsible for developing their own EA/HCP, the Service developed a template EA/HCP for Bastrop County that simplifies and helps avoid costs typically associated with developing these documents. The development of an EA/HCP can be complex and require some degree of expertise and training. The Service developed the template EA/HCP so that landowners needing assistance in developing their own EA/HCP could avoid consulting and other fees commonly incurred. Thus, the template has helped alleviate some expenses involved in the permitting process. To further expedite the endangered species permitting process while providing significant benefits to the Houston toad, the option of providing mitigation payments to the Houston Toad Conservation Fund has been made available to landowners wanting to construct single-family residences or other similar structures in Bastrop County and is included as a condition in the template EA/HCP. A number of EA/HCPs have already been approved using this template, and permits have been issued that require on-site and off-site conservation measures to offset impacts to the Houston toad.

Although the above options have helped simplify and expedite the permitting process, the mandatory public permit review period and time required to customize the template EA/HCP for each specific landowner currently requires about a 4 to 6-month processing time for HCP review, approval, and, if acceptable, permit issuance. This time period is still unacceptable for most landowners. This EA/HCP for 46 existing, partially-developed subdivisions will change the time

required for a landowner to obtain an endangered species permit to construct a single-family residence or other similar structure within one of these subdivisions from months to weeks. The EA/HCP covers 46 subdivisions and is based on the habitat quality of each of those 46 subdivisions.

The HCP (Section 6.0 of this document) covers two types of subdivisions in Bastrop County: those that are considered to be in areas that support relatively low quality habitat for the Houston toad and thus are not believed to contribute substantially to the long-term conservation of this species; and, those in areas that are considered to be of medium quality habitat, and are important for maintaining connectivity between remaining patches of high quality habitat (Tables 1 and 2). The Service took a number of factors into account in determining habitat quality in Bastrop County, including underlying geologic formations, soil characteristics, presence or absence of woodlands, presence of wetlands, on-the-ground habitat characterization, and Houston toad survey information. Along with site-specific characteristics, the Service also defined habitat quality based on landscape level parameters including the proximity of a property to woodland blocks and patches of sandy soils, the overall level of development and corresponding habitat fragmentation in the area, the presence of known wetlands in the area, and the proximity to documented populations of Houston toads.

This EA/HCP is similar to the template EA/HCP (discussed above), but covers all undeveloped lots within the 46 partially developed subdivisions at once, rather than covering each lot under an individual landowner EA/HCP. Since this EA/HCP requires the same avoidance, minimization, and mitigation efforts from every lot owner within their respective section of the HCP (see Section 6.0, low or medium quality habitat subdivision), and the public had the opportunity to review this EA/HCP, no further public review will be necessary for timely issuance of individual permits under this EA/HCP, permit numbers TE-025965-1-X (low) and TE-025997-1-X (medium). This negates the need and associated costs (in both time and money) for each landowner and the Service to prepare individual HCPs and go through separate public review processes for the construction of each single-family residence or other similar structure. The biological principles upon which this EA/HCP are based are discussed in Section 5.1 and Section 6.0 herein.

This EA/HCP (in Section 6.0) establishes the conditions under which Applicants will meet the requirements for issuance of endangered species permits under the Act. Permits issued under this EA/HCP, permit numbers TE-025965-1-X (low) and TE-025997-1-X (medium), would authorize take of the endangered Houston toad and the threatened bald eagle and allow otherwise lawful development to proceed within the 46 subdivisions. This EA/HCP was developed in an attempt to provide an additional option for landowners that would be more efficient and effective than the traditional permitting process currently in use in Bastrop County. Landowners still have the option of using the template EA/HCP, developing their own EA/HCPs, or waiting until a Bastrop area HCP is developed and implemented, as they prefer.

Table 1: Partially Built-out¹ Subdivisions (4) Containing Low Quality Habitat Platted On or Before 12/31/1994
Within the Area That Includes Houston Toad Habitat in Bastrop County, Texas

	SUBDIVISION	PLAT APPROVAL DATE*
1.	Lincoln Lakes Estates	1966
2.	Lake Thunderbird Estates	1970
3.	Tahitian Village	1972
4.	Pine Forest - Unit 6	1979

*Information regarding plat approval dates for the listed subdivisions was obtained from the Bastrop County Clerks Office, Bastrop County, Texas. Subdivisions defined as “unrecorded” are those for which no legal plat record or map has been filed with the County Clerks Office. According to the County Clerks Office, there is no method of obtaining the plat approval date for unrecorded subdivisions. However, it is their opinion that the majority of the unrecorded subdivisions were platted prior to 1984, before current record keeping practices were implemented.

¹ Partially built-out refers to those subdivisions on which at least one house and utilities have been constructed on or before December 31, 1994.

Table 2: Partially Built-out² Subdivisions (42) Containing Medium Quality Habitat Platted On or Before 12/31/1994 Within the Area That Includes Houston Toad Habitat in Bastrop County, Texas.

	SUBDIVISION	PLAT APPROVAL DATE*
1.	Alum Creek Village	1984
2.	Bastrop Cove Estates	1993
3.	Bastrop Hills Homesites	1961
4.	Circle D Country Acres	1969
5.	Cricket Hollow	unrecorded
6.	Deer Trail	1979
7.	Gravelly Oaks	unrecorded
8.	Green Acres	unrecorded
9.	Idle Acres	unrecorded
10.	KC Estates	1977
11.	Kee-El Estates	unrecorded
12.	Lake Bastrop Pines	1972
13.	Lake View Estates	1966
14.	Lost Pines	1964
15.	Lost Pines Park	1963
16.	Mesa Pinto	1972
17.	Milton Property	unrecorded
18.	Ortiz Property	unrecorded
19.	Overlook	1979
20.	Park Hill Farms	unrecorded
21.	Pine Cove Estates	unrecorded
22.	Pine Forest (excluding Unit 6)	1978
23.	Pine Hill Estates	1966
24.	Pine Junction North and South	unrecorded
25.	Pine Oak Estates	1985
26.	Pine Ridge Farms	1976
27.	Pine Tree Cattle Ranch	1991
28.	Pine Valley	1980
29.	Pine View Estates	1985
30.	Pine Wood	unrecorded
31.	Piney Ridge	1978
32.	Pioneer Pines Farm	1983
33.	Ponderosa Homestead	1982
34.	Scenic Farms	unrecorded
35.	Smithville West	1982
36.	South Paige Estates	1994
37.	Spring Hollow	unrecorded
38.	The Pines of Alum Creek	1987
39.	The Pinery	unrecorded
40.	Tonkawa Hills	unrecorded
41.	Turkey Run	unrecorded
42.	Whispering Pines	1971

*Information regarding plat approval dates for the listed subdivisions was obtained from the Bastrop County Clerks Office, Bastrop County, Texas. Subdivisions defined as “unrecorded” are those for which no legal plat record or map has been filed with the County Clerks Office. According to the County Clerks Office, there is no method of obtaining the plat approval date for unrecorded subdivisions. However, it is their opinion that the majority of the unrecorded subdivisions were platted prior to 1984, before current record keeping practices were implemented.

Endangered species permits following the requirements of this EA/HCP for construction of single-family residences or other similar structures on lots in any of the 46 specific subdivisions in Bastrop County may be issued under this 46 Subdivisions HCP: (1) during a period of 5 years starting from the date of issuance of the first permit and first signed Implementing Agreement under this EA/HCP; or, (2) until complete build-out of the 46 subdivisions occurs; or, (3) until a Bastrop area HCP for Bastrop County has been approved and permitted, whichever comes first. If the five-year period comes first, the Service will review the outcome of this HCP to determine if it should be terminated, extended, or modified. Endangered species permits issued to individual landowners under this EA/HCP will be valid for a period of five years from the date of permit issuance. The Service encourages the incorporation of this HCP into a broader, Bastrop area HCP. If the Service determines that it is prudent to extend or modify the HCP, or a Bastrop area HCP is approved and permitted, additional opportunities for public review and comment will be provided.

2.0 PURPOSE AND NEED FOR ACTION

The purpose of this EA/HCP is to minimize and/or avoid adverse impacts to the federally listed endangered Houston toad and the threatened bald eagle and thereby contribute to the species' long-term survival while allowing otherwise lawful development to proceed. The proposed development necessitates an evaluation of the environmental impacts for issuance of a Section 10(a)(1)(B) permit for the preferred alternative and the other alternatives that were considered. The permit would authorize the incidental take of the federally listed endangered Houston toad and threatened bald eagle associated with the development of single-family residences or other similar structures that follow the mitigation and conservation measure requirements of this EA/HCP for 46 specific subdivisions in Bastrop County, Texas.

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 VEGETATION

Vegetation within the 46 Bastrop County subdivisions included in the EA/HCP is dominated by an island of loblolly pines (*Pinus taeda*), known as the "Lost Pines" area. The Lost Pines constitutes the most extensive stand of loblolly pine west of the East Texas pine belt (SCS 1979). The Lost Pines is an area generally described as being between Highway 290 and the Colorado River, in Bastrop County. The Lost Pines and the area north of Highway 290 to the Lee County line are dominated by pines and a variety of oaks and other deciduous trees, including post oak (*Quercus margaretta*), blackjack oak (*Quercus marilandica*), sandjack oak (*Quercus incana*), hickory (*Carya spp.*), and cedar elm (*Ulmus crassifolia*). Other native vegetation includes little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), purpletop (*Tridens flavus*), beaked panicum (*Panicum anceps*), and shrubs. Common understory plants include yaupon (*Ilex vomitoria*), mesquite (*Prosopis spp.*), and eastern red cedar (*Juniperus virginiana*). Historically, most of Bastrop County consisted of pine/oak woodlands (SCS 1979). However,

much of the area has been logged, converted to pastureland, and/or developed for residential use.

The Lost Pines forest represents a disjunct biological community that is extremely unique and diverse, because it occurs at the junction of two physiognomic regions—the East Texas Pineywoods and the Prairies and Cross Timbers. Therefore, it contains many species that are adapted to pine forest, post oak forest, eastern deciduous forest, and prairies where openings in the forests occur.

3.2 WILDLIFE

Wildlife occurring in the Lost Pines and in and around the 46 subdivisions include many species common to pine/oak woodlands. Over 200 species of migratory birds occur in Bastrop County. Common bird species include northern mockingbird (*Mimus polyglottos*), northern cardinal (*Cardinalis cardinalis*), Carolina chickadee (*Parus carolinensis*), tufted titmouse (*Parus bicolor*), black and white warbler (*Mniotilta varia*), pine warbler (*Dendroica pinus*), the barred owl (*Strix varia*), and woodpeckers (including the pileated, *Dryocopus pileatus* and the red-bellied, *Melanerpes carolinus*). Common mammals include white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphus virginiana*), fox squirrel (*Sciurus niger*), eastern cottontail (*Sylvilagus floridanus*), nine-banded armadillo (*Dasypus novemcinctus*), striped skunk (*Mephitis mephitis*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), white-footed mouse (*Peromyscus leucopus*), northern pygmy mouse (*Baiomys taylori*), hispid cotton rat (*Sigmodon hispidus*), eastern woodrat (*Neotoma floridana*), evening bat (*Nycticeius humeralis*), red bat (*Lasiurus borealis*), and Mexican freetail bat (*Tadarida brasiliensis*). Common reptiles and amphibians include snapping turtle (*Chelydra serpentina*), Texas rat snake (*Elaphe obsoleta*), patch-nosed snake (*Salvadora grahamiae*), northern fence lizard (*Sceloperus undulatus*), ground skink (*Scincella lateralis*), Woodhouse's toad (*B. woodhousei*), and the Gulf Coast toad (*B. valliceps*).

Because the Lost Pines represents a disjunct vegetational community, it is not surprising that this area also supports many rare animal populations. Unique biota include the short-tailed shrew (*Blarina* sp.), which has only been found in Bastrop State Park (Dixon et al. 1990), and a disjunct population of the gold-stripped darter (*Etheostoma parvipinne*) in Alum Creek. The shrew is distinct from two similar species of shrew found in Texas (*B. carolinensis*, which occurs in East Texas, and *B. hylophaga*, found only along the Gulf Coast in Aransas County). In Bastrop State Park, the short-tailed shrew was found in an area of sandy soil, dense new growth loblolly pine, and old fallen logs (Dixon et al. 1990). The Alum Creek population of gold-stripped darter is the westernmost population of this species, which ranges from the Navasota River in East Texas to Georgia and Tennessee.

In addition to the species listed above, there are five other rare species that occur in Bastrop County. These include four birds: the Audubon's oriole (*Icterus graduacauda audubonii*), the reddish egret (*Egretta rufescens*), the loggerhead shrike (*Lanius ludovicianus*), and the white-faced ibis (*Plegadis chihi*); and one reptile: the Texas horned lizard (*Phrynosoma cornutum*).

Available information on these species indicates that their populations are vulnerable, but there is not enough data to support federal listing at this time. Therefore, these species do not currently receive statutory protection under the Act, but would certainly benefit from the conservation and mitigation measures in this EA/HCP.

3.3 LISTED, PROPOSED, AND CANDIDATE SPECIES

The Service has listed two species that occur in Bastrop County: the threatened bald eagle and the endangered Houston toad.

Bald Eagle (*Haliaeetus leucocephalus*)

In 1978, the bald eagle was listed under the Act as endangered in 43 states and threatened in five (Wisconsin, Minnesota, Michigan, Washington, and Oregon) (*Federal Register* March 11, 1967; February 14, 1978). Since that time, the bald eagle nesting population has almost tripled. The earliest census of the bald eagle breeding population in the lower 48 states was conducted in 1963. At that time, less than 500 pairs of birds were found. Thirty-three years later, a ten-fold increase has been recorded. The bald eagle also occurs in Alaska and Canada, where it is not at risk and is not protected under the Act. However, it remains protected under the Bald Eagle Protection Act, the Migratory Bird Treaty Act, and the Lacey Act. On July 12, 1995, the Service reclassified the bald eagle from endangered to threatened throughout the 48 conterminous States (*Federal Register*, July 12, 1995).

The bald eagle is a large raptor. The characteristic adult plumage consists of a white head and tail with a dark brown body. Juvenile eagles are chocolate brown to blackish, sometimes with white mottling on the tail, belly, and underwings. They do not fully develop the majestic white head and tail until the fifth or sixth year of life. Fish are the primary food source, but bald eagles will also take a variety of birds, mammals, and turtles (both live and as carrion) when fish are not readily available. Adults average about three feet from head to tail, weigh approximately 10-12 pounds, and have a wingspread that can reach seven feet. Generally, female bald eagles are somewhat larger than males.

The bald eagle is a regular migrant and winter resident in the eastern half of Texas and is usually associated with large bodies of water. In Bastrop County, bald eagles are known to nest along the Colorado River and its tributaries (Texas Parks and Wildlife Department, unpubl. data). They are a rare to uncommon winter resident in the Lost Pines region (Freeman 1996). Preferred nesting habitat in Texas includes river systems or lake shores with large, tall (40-120 ft.) trees for nesting and roosting. Nests are usually located within 1 or 2 miles of large bodies of water, such as lakes, reservoirs or rivers, and are often located in the ecotone or edge between forest and marsh or water. Bald eagles often build their nests in the tallest trees in an area, providing an unobstructed flight path to the nest. In east Texas, eagles nest primarily in loblolly pine. Open water or wetland areas located within about 1 mile of nesting habitat are needed to provide feeding areas (Campbell 1995).

Houston Toad (*Bufo houstonensis*)

The Houston toad was listed as endangered on October 13, 1970 (35 FR 16047) and Critical Habitat was designated in Bastrop and Burleson counties on January 31, 1978 (43 FR 4322; 50 CFR 17.95). This species was first discovered in the Houston area and was formally recognized as a distinct species in 1953. By the 1970s, toad populations spanning three counties (Harris, Fort Bend, and Liberty) disappeared from the Houston area due to urban expansion (USFWS 1984). Current populations occur where there are pine and/or oak woodlands along narrow bands of geologic formations that support sandy soils. Houston toads have been documented in nine counties since 1989—Austin, Bastrop, Burleson, Colorado, Lavaca, Lee, Leon, Milam, and Robertson (Yantis 1989-1992). The toad may also exist in Freestone and southern Bastrop counties, but no populations have been confirmed. Houston toads have not been found in Lavaca County since 1991 (Yantis 1989-1992, 1994), or at the Critical Habitat site in Burleson County since 1983 (Dixon 1983, Yantis 1989-1992), although additional surveys are warranted to confirm their absence from these areas. The Lost Pines forest in Bastrop County continues to support the largest remaining population of Houston toads, throughout their limited range. This Lost Pines population is under intense threat from development activities. Recent trend analyses indicate that Houston toad numbers in Bastrop State Park are declining (USFWS 1999).

The Houston toad occurs on rolling uplands characterized by pine and/or oak woodlands (loblolly pine, post oak, blackjack oak, or sandjack oak) underlain by pockets of deep sandy soils. Because the skin of Houston toads is semi-permeable to water, they become dormant to escape harsh weather conditions, such as winter cold (hibernation) and drought (estivation). They seek protection during this time by burrowing into sand or hiding under rocks, leaf litter, logs, or in abandoned animal burrows. Although Houston toads are typically associated with woodland habitat, they also breed in and migrate across sparsely wooded and cleared areas near woodlands. They may also breed in and traverse areas that do not support deep sandy soils, including clay and gravel substrate, provided these areas are near woodlands underlain by pockets of deep sandy soils.

Houston toads are generally brown and speckled. However, individual toad coloration can vary considerably. Some appear to be light brown and others almost black. They also may have a slightly reddish, yellowish, or greyish hue. Their legs are banded with darker pigment, and there are two dark bands extending from each eye down to the mouth. A variable white stripe streaks along the sides of the toad's body. The undersides are usually pale, with small, dark spots. Males have a dark throat which appears bluish when distended. Adult Houston toads are 2-3 inches long, and like all toads, are covered with paratoid glands, which contain chemicals that make the toad distasteful, and sometimes poisonous, to predators. Adult toads are indiscriminate feeders and eat a wide variety of insects and other invertebrates (USFWS 1984).

Houston toads breed from January to June with a peak in February and March. Male and female Houston toads have been observed at breeding ponds that are almost 1 mile apart (Andy Price,

Texas Parks and Wildlife Department, unpubl. data). This species typically uses ephemeral rain pools for breeding, although it has been known to breed in flooded fields and permanent ponds (USFWS 1984). It appears to prefer ephemeral pools over permanent ponds (USFWS 1999) and needs shallow water areas for breeding. In wet years, breeding may occur wherever sufficient standing water is present. For successful breeding, water must persist for at least 30-60 days to allow egg hatching, tadpole maturation, and emergence of toadlets (Hillis et al. 1984; USFWS 1984). Algae and pollen found in permanent or ephemeral water bodies comprise the primary source of food for tadpoles (Hillis et al. 1984). Mortality in young is high due to predation and drying of breeding sites, and less than 1% of eggs laid are believed to survive to adulthood (USFWS 1994).

Following metamorphosis, juveniles disperse into terrestrial habitats. Many amphibians use terrestrial sites at substantial distances from the nearest breeding pond (Dodd and Cade 1998). Members of the *Bufo* genus are among the most terrestrial anurans (frogs and toads) (Landreth and Ferguson 1968). They live continually on land following metamorphosis and return to water only briefly during the breeding season (Christein and Taylor 1978). Woodlands function as a “life zone” for many amphibians like the Houston toad, and provide habitat needed for feeding, growing, maturation, and maintenance of juvenile and adult breeding populations (Semlitsch 1998). Woodlands also provide habitat partitioning needed to protect the toad from competition, important cover from predators, and substrates that support Houston toad food supplies. Thus, both aquatic and terrestrial habitats are critical to the reproduction and survival of the toad.

The association between forests and amphibians is one of the most consistent landscape-scale habitat relationships reported in the literature (Fahrig et al. 1995; Findlay and Houlihan 1997; Semlitsch 1998; Knutson et al. 1999). Amphibians are one of the most abundant vertebrates in temperate forest ecosystems and play a critical role in nutrient cycling (Demaynadier and Hunter 1998). In turn, forests provide habitat for amphibians during their non-breeding season and provide a refuge in urban and agricultural landscapes (Knutson et al. 1999). Forests help stabilize temperatures, moderate evaporation rates of aquatic habitats, contribute organic matter, and add diversity to the plant and animal communities (Knutson et al. 1999). Because of the toad’s dependence on forested areas, conservation actions that focus solely on its breeding sites are unlikely to be successful (Laan and Verboom 1990; Pechmann and Wilbur 1994; Findlay and Houlihan 1997; Dodd and Cade 1998; Gibbs 1998; Semlitsch 1998). Forests provide habitat continuity and are needed to maintain dispersal corridors between breeding and terrestrial habitats (Laan and Verboom 1990; Rudolph and Dickson 1990; Welsh 1990; Demaynadier and Hunter 1998; Gibbs 1998; Knutson et al. 1999).

Threats

Several reasons have been cited for increased extinction rates of plant and animal species, including decreased habitat size and quality, increased distance from similar habitats, the degree of difference in the intervening matrix, changes in biotic and abiotic properties of habitats, and ecosystem vulnerability to extrinsic disturbances (Harris 1984; Lord and Norton 1990; Reh and Seitz 1990; Soule et al. 1992; Pechmann and Wilbur 1994; Vos and Chardon 1998). These

elements are especially critical for rare ecosystems such as the Lost Pines. The smaller the habitat remnant, the faster its biota will collapse; persistence time increases in proportion to population size of the biota (Soule et al. 1992). Providing several large tracts of high quality habitat, avoiding fragmentation, maintaining connectivity, buffering from negative effects, and instituting habitat management greatly influence the persistence of species (Shafer 1997).

Small, sedentary species like the Houston toad, with restricted distributions, specialized habitat niches, and narrow climatic tolerances are particularly vulnerable (Welsh 1990; Demaynadier and Hunter 1998). Population viability analyses for the Houston toad indicate that risk of extinction increases with reduced migration, survivorship, reproductive success, and continued gradual and sustained reduction of available habitat. Population survival is enhanced by maintaining several populations of relatively large and equal sizes that are interconnected to allow dispersal and recolonization to occur (USFWS 1994).

Loss and Fragmentation of Terrestrial Habitat

Primary threats to the Houston toad include the destruction, conversion, and fragmentation of habitat throughout its range as a result of urbanization, logging, and agricultural production. Habitat conversion, often being permanent, poses the most serious threat to the Houston toad. Woodlands inhabited by the toad have been destroyed, degraded, and/or made sub-optimal by increased suburban sprawl.

Since the Houston toad, like many anurans, is primarily associated with woodlands (although it is known to use breeding sites in more open areas near woodlands), clearing of woodlands and understory vegetation results in inhospitable environmental conditions (Laan and Verboom 1990; Rudolph and Dickson 1990; Welsh 1990; Findlay and Houlahan 1997; Demaynadier and Hunter 1998; Dodd and Cade 1998; Gibbs 1998; Semlitsch 1998; Knutson et al. 1999). The loss of woodland vegetation can lead to increased temperature (and drying) of the surrounding environment with a concomitant shift in plant and animal communities (effects may include an increase in non-native plant and animal species). In addition, there is increased potential for contamination due to increased rates of run-off and sedimentation from soil erosion. The Houston toad is then at risk of dehydration due to increased ambient temperatures and reduced moisture and humidity. Physiological constraints, coupled with relatively poor dispersal capabilities and small home ranges cause many amphibian species to be especially sensitive to habitat loss and degradation (Welsh 1990; Demaynadier and Hunter 1998).

Large habitat patches generally contain larger animal and plant populations with lower extinction probabilities, and these larger patches tend to be occupied more often than smaller ones (Soule et al. 1992). Habitat destruction and degradation contribute to habitat fragmentation (smaller patches with greater distances between patches). Increased fragmentation isolates habitat and increases the Houston toad's vulnerability to adverse impacts, including predation, interspecific competition, and reduced food availability. Habitat fragmentation contributes to the genetic isolation of populations or population fragmentation (which in turn can reduce genetic variation and viability necessary to produce healthy offspring). This increases the risk of extinction by

reducing survival, reproduction, and dispersal. Isolation also precludes recolonization should one or more populations be eliminated. Risks are compounded when populations are surrounded by an inhospitable environment that continually imposes a high degree of threats on the remnant habitat (Denton et al. 1997; Laan and Verboom 1990; Reh and Seitz 1990; Soule et al. 1992; Pechmann and Wilbur 1994; Shafer 1997; Gibbs 1998; Semlitsch 1998; Vos and Chardon 1998). As numbers of populations are reduced and numbers of individuals in populations decline, the species also becomes vulnerable to catastrophic events, such as severe and prolonged drought conditions. Droughts may reduce small populations to such low numbers that they are unable to recover (Soule et al. 1992; Pechmann and Wilbur 1994).

Even small amounts of habitat fragmentation (such as paved roads less than 10 feet wide), can prevent dispersal and effectively isolate populations of some invertebrates, small mammals (Mader 1984; Mader et al. 1990), and amphibians (Van Gelder 1973; Reh and Seitz 1990; Soule et al. 1992; Fahrig et al. 1995; Yanes et al. 1995; Findlay and Houlihan 1997; Gibbs 1998; Vos and Chardon 1998; Knutson et al. 1999). This barrier effect may be due to behavioral avoidance of roads or other edges, changes in microclimate conditions next to roads, vehicle emissions, environmental instability when roadside vegetation is cut or sprayed with fertilizers and/or pesticides, increased predation and/or competition along the road edge, mortality from roadway traffic, and/or other associated factors.

Loss/Degradation of Breeding Habitat

Small wetlands are crucial to the survival of many amphibians, other vertebrates, and invertebrate species. Water is an important factor in the survival of the Houston toad, since reproduction cannot occur without adequate water in breeding pools. Houston toads typically prefer to breed in small, temporary pools that may be destroyed or degraded during modern agricultural practices, logging operations, and/or urbanization. Run-off, erosion, and application of pesticides and fertilizers may contaminate breeding sites. Since Houston toads require shallow areas for breeding activities, deepening ponds or pools may effectively eliminate breeding and attract predators (Denton et al. 1997; Hecnar and M'Closkey 1997; Kupferberg 1997; Knutson et al. 1999) and competitors (see interspecific competition, below). The creation of stock ponds, recreational fishing ponds, or other permanent water bodies also provide avenues for invading species such as bullfrogs (*Rana catesbeiana*), which have been known to have severe detrimental effects on native amphibians and reptiles through predation and/or competition (Kupferberg 1997). Bullfrogs were first reported in Bastrop State Park in 2000 (Andy Price, TPWD, pers. comm., 2000).

Stocking predatory fish into ponds, tanks, or other potential breeding sites likely alters amphibian species assemblages and reduces community diversity on a geographic scale (Hecnar and M'Closkey 1997). Predatory fish can reduce the abundance of amphibians, eliminate subpopulations, and/or cause local extinctions (Hecnar and M'Closkey 1997). Lack of defenses may explain why temporary pond species like the Houston toad may not be able to coexist well with introduced fish in permanent water (Hecnar and M'Closkey 1997). Predatory fish could affect the Houston toad directly, by preying on eggs and tadpoles, or indirectly by introducing

pathogens, including viruses, bacteria, and fungi. The fungus *Saprolegnia* is a worldwide pathogen of fishes that attacks eggs, larvae, and adult fishes, and is especially prevalent in fish that are hatchery-reared (Blaustein et al. 1994). This fungus has also been shown to infect the eggs, tadpoles, and adults of anurans, including *Bufo* species, and is one of the factors recently attributed to the disappearance of frogs and toads from breeding ponds in the wild (Blaustein et al. 1994). Voris and Bacon (1966) found that tadpoles of the American toad (*B. americanus*) (related to the Houston toad) are relatively free from fish predation. However, research has also shown that although the American toad and Woodhouse's toad appear to be unpalatable to largemouth bass, the bass will prey on these species when other food is scarce or unavailable (Kruse and Stone 1984).

Protecting woodland habitat adjacent to breeding sites is also essential to conserving breeding habitat. Woodlands provide habitat continuity needed to allow for movement between ponds and recolonization of local population extinctions (Laan and Verboom 1990; Rudolph and Dickson 1990; Welsh 1990; Demaynadier and Hunter 1998; Gibbs 1998; Knutson et al. 1999). The loss of woodlands that support the terrestrial phase of the toad's life would most likely reduce recruitment of juveniles into the breeding population, adult survival, and the persistence of the population (Laan and Verboom 1990; Pechmann and Wilbur 1994; Findlay and Houlahan 1997; Dodd and Cade 1998; Gibbs 1998; Semlitsch 1998).

Interspecific Competition

The Houston toad's range overlaps with only two other *Bufo* species, Woodhouse's toad and the Gulf Coast toad. Woodhouse's toad occurs in a variety of habitats and is the most widespread toad in North America. The Houston toad appears to be a poor competitor that has retreated and adapted to an environment where, under natural conditions, few interspecific interactions occur (Yantis 1989). The presence of woodlands provides an important separation between the habitat of the Houston toad and Woodhouse's toad. Although the breeding seasons of the Houston toad and Woodhouse's toad are similar, their different habitat requirements tend to keep them separated. In Bastrop County, the Houston toad occurs throughout the pine forest, while Woodhouse's toad populations surround the forest. Since Woodhouse's toads are generally found in more open habitats, land clearing practices can quickly diminish numbers of Houston toads in favor of Woodhouse's toads. Hybridization between these two species occurs primarily along habitat edges where the forest has been cleared and permanent ponds have replaced ephemeral pools (USFWS 1984).

The Gulf Coast toad is primarily a lowland species with a range that extends from Louisiana and Texas south to Costa Rica. The primary isolating mechanism between the Houston toad and the Gulf Coast toad is the separation of their breeding seasons – the Gulf Coast toad tends to breed later in the year. However, there is some overlap in the breeding seasons, particularly when breeding in the Houston toad is delayed due to cold weather. The Gulf Coast toad also tends to prefer permanent breeding ponds rather than the temporary rain pools used by the Houston toad, so some degree of habitat partitioning also occurs between these two species. Elimination or modification of temporary rain pools, or their conversion to permanent ponds, forces Houston

toads to use permanent ponds where they may be outnumbered by Gulf Coast toads (USFWS 1984).

Differences in species densities may also be an important factor contributing to interspecific competition and hybridization (Brown 1971). The Houston toad is soon replaced by Woodhouse's or Gulf Coast toads in areas where these species are more abundant. An abundance of Woodhouse's or Gulf Coast toads is an indication that Houston toads may be absent (Yantis 1991). Brown (1971) documented a location near Bastrop State Park where Woodhouse's toads rapidly invaded a Houston toad breeding pond following land clearing. Hybridization was reported shortly after the area had been cleared (Brown 1971), and the Houston toad later disappeared from this site. However, the Houston toad appears to have a competitive advantage at sites where it outnumbers Woodhouse's and Gulf Coast toads (that is, woodland habitat with ephemeral ponds).

Predators (Native and Non-native)

Native predators of Houston toads include birds, mammals, snakes, and turtles. Introduction of domestic pets, particularly house cats and dogs, and an increase in some native mammals (raccoons and opossums) generally accompanies human settlements and can have impacts on amphibian and other vertebrate populations (Soule et al. 1992). The red-imported fire ant (*Solenopsis invicta*) also tends to benefit from destruction of woodland habitat and the presence of humans (Tschinkel 1988, Porter et al. 1988, 1991). Where fire ant infestations occur, they undoubtedly impact the toad both directly and indirectly through predation and competition. Fire ants have been observed preying on newly-metamorphosed Houston toads (less than 10 days old) as they emerged from the water (Freed and Neitman 1988). The fire ant is an aggressive predator, and current evidence shows that it has a devastating and long-lasting impact on native ant populations and other invertebrate communities (Vinson and Sorensen 1986, Porter and Savignano 1990), which provide food for the Houston toad.

Research in some areas, including the fire ant's native range, indicate that fire ants are associated with open habitats disturbed as a result of human activity (i.e.; old fields, lawns, roadsides, ponds, and other open, sunny habitats), but are absent or rare in late succession or climax communities such as mature forest (Tschinkel 1988). Thus, maintaining large, undisturbed areas of woodlands may help control the spread of fire ants (Porter et al. 1991) and protect native ant populations (Porter et al. 1988, 1991; Suarez et al. 1998). Several native ants are known to attack and kill founding fire ant queens and are especially important in deterring fire ants from colonizing non-infested areas (Porter et al 1991).

Vehicle strikes

Traffic mortality has a significant negative effect on local population densities of some invertebrates, small mammals (Mader 1984; Mader et al. 1990), and amphibians (Van Gelder 1973; Reh and Seitz 1990; Soule et al. 1992; Fahrig et al. 1995; Yanes et al. 1995; Findlay and Houlahan 1997; Gibbs 1998; Vos and Chardon 1998; Knutson et al. 1999). Roadways eliminate and fragment habitat and result in mortality from vehicle strikes, presenting a serious threat to

survivorship and dispersal (Reh and Seitz 1990; Fahrig et al. 1995; Findlay and Houlahan 1997; Vos and Chardon 1998) through reduced connectivity and migration among remnant habitat patches (Reh and Seitz 1990; Fahrig et al. 1995; Findlay and Houlahan 1997; Vos and Chardon 1998). Amphibians that are slow-moving and ground-dwelling are especially vulnerable to roadway mortality (Vos and Chardon 1998).

Roadway mortality can severely impact amphibian populations (Vos and Chardon 1998). The proportion of mortality from vehicle strikes increases with increasing roadway density and traffic (Fahrig et al. 1995; Vos and Chardon 1998). Reh and Seitz (1990) found that common frogs (*Rana temporaria*) are particularly vulnerable to increasing traffic density and that roadways represent a significant barrier to dispersal. Surveys along a 5-mile stretch of Highway 21 in Bastrop County during 1990 reported 67-84% mortality of the Houston toads observed (Dixon et al. 1990; Price 1990; TxDOT 1993). Van Gelder (1973) found that about 30% of female European toads (*Bufo bufo*) crossing a 13-foot wide asphalt road, with traffic equal to about 10 cars/hour, were run over. Later studies concluded that 24-40 cars/hour killed 50%-100% of amphibians crossing the roads (Fahrig et al. 1995; Vos and Chardon 1998).

The presence of forest generally has a positive effect on toad densities (Fahrig et al. 1995), and the removal of forest associated with road construction can pose significant risks to wetland biodiversity (Findlay and Houlahan 1997) and isolation of breeding ponds (Vos and Chardon 1998). Vos and Chardon (1998) suggest that the distribution of suitable terrestrial habitat may be a limiting factor due to high mortality in the terrestrial phase of the amphibians' life cycle, and that dispersal may be more effective in landscapes with large proportions of suitable habitat. Other road-related factors, such as pollutants in road run-off, exhaust emissions, vibrations, and noise, may also affect toad densities either by causing direct mortality or by interrupting behavior (Fahrig et al. 1995).

Pesticides, Fertilizers, and Contaminants

Pesticides and other chemicals may impact the Houston toad directly, particularly during the aquatic phase of its life cycle, and/or indirectly by lowering the abundance and diversity of its food supply. Research indicates that amphibians, particularly their eggs and larvae, are sensitive to many pollutants, such as heavy metals, certain insecticides (particularly cyclodienes, such as endosulfan, endrin, toxaphene, and dieldrin), nitrites, salts, certain organophosphates (such as parathion and malathion), and petroleum hydrocarbons (Harfenist et al. 1989). Because of the semipermeability of the Houston toad's skin, the development of their eggs and larvae in water, and their position in the food web, these amphibians can be exposed to waterborne and airborne pollutants (Bishop and Pettit 1992). Pesticides can change the quality and quantity of amphibian food and habitat (Bishop and Pettit 1992). The amount and quality of food and shelter may be reduced when insecticides and herbicides contaminate wetland ecosystems. Pesticides can change or reduce macrophyte, algal, and invertebrate populations, resulting in a loss of food and/or cover for adult and young Houston toads and tadpoles.

Pesticides may enter the Houston toad's habitat through direct application, drift from sprays, and/or through agricultural and urban run-off. Herbicides used along highways and other roads, as well as roadway run-off, may be harmful to the Houston toad. The commonly used herbicide Atrazine has been shown by Hazelwood (1970) to seriously affect frog eggs. Pesticides commonly used by area residents are also likely to adversely impact Houston toads. Heavy metals and petroleum hydrocarbons deposited by automobiles along highways may accumulate to the point of becoming toxic to the Houston toad. Toxic effects to amphibians from pollutants may be either lethal or sub-lethal, including morphological and developmental aberrations, lowered reproduction and survival, and changes in behavior and certain biochemical processes.

Edge Effects and Small Population Size

Maintaining adequate areas of native vegetation is essential to prevent detrimental “edge effects” (i.e.; heating, drying, shift in species composition and abundance, increased predation/competition, invasion of exotic species). Edge effects are changes to the floral and faunal communities where different habitats, such as forest/pasture, forest/clear-cut, or forest/suburb, meet. The length and width of the edge, as well as the contrast in types of land cover between the habitats, all contribute to the amount of impacts that an edge can produce (Harris 1984; Smith 1990). Some types of edge effects include increases in solar radiation, changes in soil moisture due to elevated levels of evapotranspiration, and wind buffeting (Ranny et al. 1981), changes in nutrient cycling and disruptions to the hydrological cycle (Saunders et al. 1990), and changes in the rate of leaf litter decomposition (Didham 1998). These edge effects cause disruptions in native plant communities, which in turn impact associated animal species. The effects of edge on animal communities generally are greater than the effects on vegetation communities (Wilcove et al. 1986).

The more edge a habitat fragment or patch has, the larger the patch or fragment size should be to protect the core area from the deleterious edge effects (Ranny et al. 1981; Lovejoy et al. 1986; Yahner 1988; Laurance 1991; Laurance and Yensen 1991; Kelly and Rotenberry 1993; Holmes et al. 1994; Turner 1996; Reed et al. 1996; Suarez et al. 1998). Minimizing edge effects in a preserve design means keeping the edge/area ratio low by increasing patch size (Holmes et al. 1994) and/or using optimal preserve shapes. Circular preserves, or ones that are connected to other preserves, are preferable (Diamond 1975; Wilcove et al. 1986; Kelly and Rotenberry 1993; Wigley and Roberts 1997; Kindvall 1999). A preserve with a circular configuration will have less edge than a preserve of equal size with any other configuration.

For vegetation, edge effects have been documented to extend inward from the margin to between 52 and 449 feet (Jiquan et al. 1992; Stefan and Fairweather 1997; Meiners and Steward 1999). These edge effects include decreased density, elevated tree mortality, increased growth rates and recruitment of dominant species (Jiquan et al. 1992), increased proportions of exotic species, decreased proportions of native species (Stefan and Fairweather 1997), and changes in species richness and percentage of cover (Meiners and Steward 1999).

For animal communities, reported edge effects are typically 164 to 328 feet or greater (Lovejoy et al. 1986; Wilcove et al. 1986; Laurance 1991; Laurance and Yensen 1991; Kapos et al. 1993; Andren 1995; Reed et al. 1996; Burke and Nol 1998; Didham 1998; Suarez et al. 1998). Suarez et al. (1998) found that densities of the Argentine ant, an exotic species with a life history similar to the fire ant, are greatest within 328 feet, and rare or absent within 656 feet, of an urban edge. Native ant communities tend to be more abundant in native vegetation and less abundant in areas with exotic vegetation. Edges and their associated effects often allow just enough disruption for invasive species to gain a foot-hold where native vegetation had previously prevented their spread (Saunders et al. 1990; Kotanen et al. 1998; Suarez et al. 1998; Meiners and Steward 1999). The invasion of red-imported fire ants is known to be aided by “any disturbance that clears a site of heavy vegetation and disrupts the native ant community” (Porter et al. 1988). Thus, maintaining large, undisturbed areas of woodlands can help sustain native ant communities needed to help combat the fire ant threat (Porter et al. 1988; Porter et al. 1991).

The detrimental effects of edge increase as the size of a habitat patch decreases. Small, isolated populations are much more vulnerable to extinction than populations within large, contiguous patches (Diamond 1975; May 1975; Wilcove et al. 1986; Soule et al. 1992; Denton et al. 1997; Gibbs 1998). Local populations occurring on small habitat patches have higher probabilities of extinction than those on larger patches, because populations on small patches lose more emigrants than are compensated for by immigration. Immigrants reduce the risk of extinction of local populations by a “rescue” effect, since colonizations are necessary to compensate for local extinctions. The ability of individuals to move between preferred habitat patches is essential for colonization and population viability (Fahrig and Merriam 1994; Kattan et al. 1994; Eber and Brandl 1996; Hill et al. 1996; Kozlov 1996; Kuussaari et al. 1996; Turner 1996; Kindvall 1999). Some studies demonstrate higher emigration as patch size decreases, while higher immigration tends to increase as patch size increases (Kuussaari et al. 1996; Kindvall 1999). Large circular or square patches tend to have less emigration than narrow, elongated patches because the probability of encountering a patch boundary decreases with increasing patch size and decreasing edge/patch ratios. Likewise, large patches have a higher probability of colonization than small patches. Patch shapes that allow connection with the highest number of neighboring patches increases the likelihood that a neighboring patch will be occupied (Fahrig and Merriam 1994; Kuussaari et al. 1996; Tiebout and Anderson 1997; Kindvall 1999). If movement between populations is restricted and a population is isolated, the habitat patch size must be large enough to ensure population survival on its own (Fahrig and Merriam 1994).

Threats from Agriculture

Agricultural production (including timber harvesting) contributes to the loss of habitat through the conversion of woodlands to pasture or cropland; the draining, filling, or deepening of wetlands important for Houston toad reproduction; soil compaction; application of fertilizers and pesticides; and/or mortality or disturbance of aestivating toads (Knutson et al. 1999). Conversion of woodlands to exotic sod-forming grasses (such as bermudagrass) and other cover types increases threats of competition to the Houston toad by providing habitat for Woodhouse's toad and the Gulf Coast toad, increases Houston toad exposure to predators, and hinders Houston toad

mobility and dispersal capabilities. Habitat conversion also encourages the establishment of fire ants.

Threats from Urbanization

Knutson et al. (1999) conducted a study that concluded a consistent negative association between the presence of urban land and effects across all anuran guilds. Inhospitable habitats are created through the building of roads, homesites and similar structures, and commercial/industrial areas; exotic turfgrasses; increased vulnerability to predators and competitors; loss or degradation of breeding ponds; application of pesticides; and fire ants. These factors work synergistically with the detrimental effects of habitat fragmentation to decrease the numbers and distribution of toad populations, and ultimately may lead to local toad extinctions.

The adverse effects of residential development on the demography of Houston toads are likely due to a combination of factors. The construction of homes and associated infrastructure results in permanent habitat loss, degradation, and fragmentation (including conversion of woodlands to sod-forming turfgrass lawns and other exotic vegetation, soil compaction, erection of privacy fencing, introduction of imported top soils, and application of pesticides). Direct mortality of toads may occur during site clearing, preparation, and construction. In addition, residential development increases road and traffic densities with the increased likelihood of mortality from motor vehicle strikes. These terrestrial habitat changes inhibit Houston toad mobility and dispersal needed for survival (access to food and breeding sites, protection from predators and competitors, genetic exchange, etc.), eliminate shelter (sandy soils, leaf litter, or animal burrows) needed to escape predators and adverse weather conditions (cold, heat, and drought), reduce the abundance and diversity of invertebrate communities that the Houston toad feeds on, create habitat conditions favored by predators and competitors, and result in the direct mortality of toads (including roadkill and during construction activities).

Suburban development can also result in the destruction or degradation of breeding ponds so that reproduction declines or ceases. Breeding sites may be destroyed during the construction of homesites, septic systems, and lawns. Some homeowners may eliminate, enlarge, or aerate breeding ponds in an effort to discourage breeding mosquitos. Ponds may also be stocked with fish. Since Houston toads require shallow areas for breeding activities, deepening ponds may effectively eliminate breeding and/or increase predation and competition that reduces survival and reproduction.

Habitat changes and associated edge effects increase the Houston toad's exposure to competition from Woodhouse's and Gulf Coast toads and predators, including domestic pets (dogs and cats) and native mammals (raccoons and opossums) that are attracted to predictable food sources found in residential areas (trash cans and pet food dispensers), and fire ants. Fire ants may be introduced through imported top soils and nursery plants, and/or may increase in intensity and distribution due to land clearing and suburban development. The increasing density of human activities also increases the chances of encountering toads and the potential for humans pursuing,

trapping, capturing, and/or collecting Houston toads, and either accidentally or intentionally wounding or killing toads. Malicious killing of other toad species has been documented in some residential areas. These factors work together to decrease the numbers and distribution of toads, making them more vulnerable.

Fragmentation of habitat due to suburban development increases the rate of local extinctions beyond that which would be expected from habitat loss alone. As Houston toads are forced into smaller habitat patches, they are exposed to greater pressures from predation and competition. It is more difficult for Houston toads to hide from predators and compete with congeners as habitat patches decrease in size. In addition, as toads travel longer distances to disperse, they are more vulnerable to deaths from depredation and vehicle strikes. Fragmented patches of marginal habitat may act as biological sinks (where mortality exceeds reproduction needed to sustain the population on its own).

The loss of Houston toads from the Houston area demonstrates the vulnerability of the toad to urbanization. The prospect for its long-term survival in urban settings is not good without careful planning. Without consideration of ecosystem stability and population viability needs, the continued pressures associated with residential development will accelerate declining trends. However, population viability may be enhanced by protecting large blocks of woodlands to support source populations needed for recolonization should local populations be eliminated, spacing these populations close together, and maintaining enough habitat (while minimizing threats between source populations) to allow for dispersal.

Protecting the ecosystem on which the Houston toad depends requires protecting the plant and animal species needed to sustain that ecosystem. This requires the preservation of a representative portion of the native community. The habitat area (patch size and configuration), quality, arrangement, and connectivity must be sufficient to maintain integrity and persistence of native plant communities, allow for dispersal of native fauna, sustain viable populations of native animal communities, preserve populations to allow for recolonization, and ensure adequate gene flow. Increasing mortality rates in native fauna (from predation, competition, roads, and urbanization) need to be avoided, minimized, and managed, as should the introduction or increase in non-native predators and competitors. Maintaining optimal habitat also requires protecting it from detrimental edge effects such as heating, drying, invasion of non-native species, and shifts in species composition and abundance by providing an adequate buffer area. Connecting habitat patches will help preserve the plant and animal communities on which the Houston toad depends by maximizing population sizes and allowing for dispersal and recolonization.

3.4 WETLANDS

Areas subject to jurisdiction under Section 404 of the Clean Water Act include those areas that fall at or below the “plane of ordinary high water” of these waterways as defined by 33 CFR 323.2. According to National Wetland Inventory (NWI) maps, several wetland areas lie within

or adjacent to the subdivisions covered by this EA/HCP and are within the area that contains known and potential habitat, including Critical Habitat, for the Houston toad in Bastrop County. These wetlands include temporarily flooded creeks or drainage areas, intermittent/seasonally flooded streambeds, numerous small, permanently flooded impoundments, unique bog habitats, several small lakes, Lake Bastrop, and the Colorado River. These temporarily and seasonally flooded drainage areas and permanently flooded impoundments provide important breeding habitat for the Houston toad, especially where shallow, temporary pools form. In addition, Bald eagles are a rare to uncommon winter resident of the Lost Pines (Freeman 1996), and are known to nest along the Colorado River and its tributaries (Texas Parks and Wildlife Department, unpubl. data).

Ephemeral (temporary) wetlands are often too small to be identified on NWI maps and may not be regulated by the Corps of Engineers. Ephemeral wetlands can include temporarily flooded drainage or low lying areas. Houston toads typically use ephemeral rain pools for breeding and appear to prefer ephemeral pools over permanent ponds (USFWS 1984; USFWS 1999).

3.5 SOILS/GEOLOGIC FORMATIONS

Houston toad habitat in Bastrop County lies primarily along the Carrizo, Queen City, Reklaw, Sparta, and Weches geological formations. These Pleistocene formations were deposited during the principle glacial episodes of the last 1-3 million years, when sea levels rose and fell numerous times. They are characterized by coarse-grained sands, almost level to gently rolling or hilly topography, high porosity and permeability, and low evaporation rates. Sands overlying these formations enable the production of heavy mesic forests of tall trees dominated by post oak in association with loblolly pine, blackjack oak, hickory, and sandjack oak (McBryde 1933).

Soils within the lots covered by this EA/HCP are classified primarily within the Patilo-Demona-Silstid and Axtell-Tabor associations. Soils within the Patilo-Demona-Silstid Association are gently sloping to strongly sloping soils that occur on uplands and have a sandy surface layer and moderately slow to moderately permeable lower layers. Soils within the Axtell-Tabor Association occur on stream terraces and uplands and are nearly level to strongly sloping, have a loamy surface layer and very slowly permeable lower layers. The predominate soil series are Patilo which consists of deep, gently sloping to strongly sloping, moderately well-drained, sandy soils and Axtell which consists of deep, nearly level to strongly sloping, well drained to moderately well drained, loamy soils (SCS 1979).

3.6 LAND USE

The 46 Subdivisions included in this EA/HCP are located in central Bastrop County within an area that has been experiencing rapid urban development (Texas State Data Center 1996, 2000). All of the subdivisions are bordered to the north by State Highway 290 (except Scenic Farms and Lincoln Lakes Estates), to the south by the Colorado River, to the west by Lake Bastrop, and to

Table 3: Summary information for the 46 subdivisions located within the area that includes habitat for the Houston toad in Bastrop County, Texas. (All numbers are estimates).

SUBDIVISION	TOTAL ACRES	DEVELOPED ACRES	UNDEVELOPED ACRES	TOTAL LOTS	DEVELOPED LOTS	UNDEVELOPED LOTS
1 Alum Creek Village	45	11	34	50	12	38
2 Bastrop Cove Estates	115	80	35	13	10	3
3 Bastrop Hills Homesites	232	215	17	55	45	10
4 Circle D Country Acres	1913	1181	732	809	465	344
5 Cricket Hollow	144	97	47	20	10	10
6 Deer Trail	77	36	41	15	5	10
7 Gravelly Oaks	140	71	69	21	10	11
8 Green Acres	30	26	4	21	17	4
9 Idle Acres	121	40	81	44	18	26
10 KC Estates	1365	1082	283	275	248	27
11 Kee-El	895	496	399	71	38	33
12 Lake Bastrop Pines	49	9	40	170	35	135
13 Lake Thunderbird	200	ND	ND	800	363	437
14 Lake View Estates	25	4	21	125	18	107
15 Lincoln Lake	160	ND	ND	640	30	610
16 Lost Pines	153	12	141	140	95	45
17 Lost Pines Park	68	19	49	25	10	15
18 Mesa Pinto	75	14	61	40	11	29
19 Milton Property	105	ND	ND	25	ND	ND
20 Ortiz Property	140	ND	ND	37	ND	ND
21 Overlook	46	20	26	9	4	5
22 Park Hill Farms	115	33	82	23	4	19
23 Pine Cove Estates	15	ND	ND	40	29	11
24 Pine Forest - Excl. Unit 6	450	228	222	325	133	192
25 Pine Forest - Unit 6	200	ND	ND	745	21	724
26 Pine Hill Estates	67	27	40	56	30	26
27 Pine Junction	150	134	16	36	31	5
28 Pine Oak Estates	64	18	46	37	13	24
29 Pine Ridge Farm	170	129	41	35	33	2
30 Pine Tree Cattle Ranch	250	125	125	21	10	11
31 Pine Valley	240	172	68	75	62	13
32 Pine View Estates	115	27	88	143	50	93
33 Pine Wood	25	11	14	21	15	6
34 Piney Ridge	500	481	19	176	141	35
35 Pioneer Pines Farm	350	260	90	150	148	2
36 Ponderosa Homestead	600	367	233	110	104	6
37 Scenic Farms	80	71	9	50	44	6
38 Smithville West	542	391	151	80	78	2
39 South Paige Estates	30	13	17	5	1	4
40 Spring Hollow	85	22	63	42	13	29
41 Tahitian Village*	2594	427	2167	6661	685	5976
42 The Pinery	55	35	20	18	10	8
43 The Pines of Alum Creek	35	25	10	10	9	1
44 Tonkawa Hills	40	35	5	32	10	22
45 Turkey Run	163	66	97	36	11	25
46 Whispering Pines	130	44	86	21	4	17
Total	13,163	6,554	6,609	12,353	3,133	9,220

* Data does not include Unit 3 of Tahitian Village (see Figure 5)

the east by Farm to Market Road 2104. State Highways 21 and 71 bisect the area. The current land uses throughout the Houston toad's range in Bastrop County are predominantly residential development and associated facilities, agricultural, or land that is currently being left vacant. The Service estimates that approximately 50,000 acres of Houston toad habitat within this area has been platted for single-family housing, cleared for agricultural use, and/or is sub-optimal in some way. Within the area that is currently considered to be sub-optimal habitat, there are approximately 12,353 total lots located within the 46 subdivisions included in this EA/HCP, of which approximately 9,220 lots, covering approximately 6,609 acres, remain undeveloped (Table 3). All lots included within this EA/HCP are currently platted for development. These lots are generally bordered by existing development or other lots that will be developed in the future. The remaining optimal, undeveloped, high quality Houston toad habitat constitutes about 58,500 acres.

Data summarized in Table 3 was obtained from the Bastrop County Central Appraisal District database and is current as of May 18, 2000. Due to the organization of the database, lots located within areas not considered habitat were not subtracted (see Figures 5-10). The Service estimates that approximately 1,170 lots are located outside of Houston toad habitat. Therefore, totals given in Table 3 may be somewhat over- or under-estimated.

3.7 WATER RESOURCES

In Bastrop County, virtually all the municipal, industrial, and irrigation water needs are supplied by groundwater from the Carrizo-Wilcox Aquifer System. Designated as one of the nine major aquifers in Texas, the Carrizo-Wilcox is a sole-source aquifer for potable water supply for Bastrop County (Kier and Larkin 1998). Formation of the aquifer is a result of the deposition of layers of coarse sand, sandy clay, and shale with some lenses of lignite and limestone forming an ancient delta complex known as the Wilcox Group. Over time, the Wilcox sediments were eroded and covered by fluvial deposits of Carrizo sand, producing the Carrizo Formation.

The Carrizo forms a massive continuous sheet of sand, which in Bastrop County, ranges from 100 to 375 feet thick (Follet, 1970; Barnes, 1974). Recharge of the aquifer occurs primarily through direct infiltration of precipitation at outcroppings in the member formations. Two other minor aquifers occur within Bastrop County, the Queen City and the Sparta.

Other major water resources in Bastrop County include the Colorado River and Lake Bastrop. Waters of the Colorado River are used for recreational purposes, as well as to fulfill some of the irrigation needs of the surrounding farms. Lake Bastrop, a man-made impoundment created in 1964, offers visitors 900 surface acres of water suitable for boating, fishing, swimming, and water skiing (Bastrop Chamber of Commerce 1999). All of the subject subdivisions lie north of the Colorado River, and the majority of them lie east or southeast of Lake Bastrop. All of the creeks discussed below, except Piney Creek, are temporarily flooded or seasonal, forested creeks or drainage areas with several permanently flooded impoundments located along each creek's route. Piney Creek is an intermittent, seasonally flooded streambed along its route adjacent to

the Piney Ridge Subdivision. In the discussion of water resources within or around the subject subdivisions, distance to a water resource was measured as the linear distance from the approximate center of the subdivision to the resource.

1. Alum Creek Village Subdivision lies approximately 1.6 miles northwest of the Colorado River. It appears that at least one small, permanently flooded impoundment is located on the subject property.
2. Bastrop Cove Estates Subdivision lies less than 1.0 mile east of Little Alum Creek, which runs through the subdivision. One small, permanently flooded impoundment is located on the property and several others are located on adjacent properties within 0.25 miles.
3. Bastrop Hills Homesites Subdivision lies approximately 2.2 miles northeast of the Colorado River and approximately 1.1 miles east of Copperas Creek. Several small, permanently flooded impoundments occur on the property and a relatively large permanent impoundment occurs on the adjacent property to the east.
4. Circle D Country Acres Subdivision lies approximately 2.5 miles east of Lake Bastrop. Two small lakes, impoundments of Spicer Creek, are located in Section 6 of the subdivision. An unnamed, intermittent, seasonally flooded streambed runs through Section 2 of the subdivision. Numerous small, permanently flooded impoundments are located throughout the subdivision.
5. Cricket Hollow Subdivision contains several permanently flooded impoundments which serve as the origin of Gravelly Creek, a seasonally flooded creek. Several other small, permanently flooded impoundments are located throughout the subdivision and occur on adjacent properties.
6. Deer Trail Subdivision lies less than 1.0 mile east of the Colorado River. At least one small, permanently flooded impoundment is located on the adjacent property to the west. It appears that no creeks, streams, or permanent ponds are located on the subject property.
7. Gravelly Oaks Subdivision lies approximately 1.0 mile north of Droemer Lake. A forested, temporarily flooded tributary of Gravelly Creek runs through a portion of the subdivision.
8. Green Acres Subdivision lies approximately 2.0 miles northeast of the Colorado River. Little Alum Creek runs along the western border and Alum Creek is approximately 1.0 mile west of the subdivision. It appears that no creeks, streams, or permanent ponds are located on the subject property.

9. Idle Acres Subdivision lies 2.5 miles northeast of the Colorado River and less than 0.25 miles east of an unnamed, forested, temporarily flooded creek. It appears that no streams, creeks, or ponds are located on the subject property.
10. KC Estates Subdivision lies approximately 1.4 miles east of Lake Bastrop. Several small, permanently flooded impoundments are located throughout the subdivision.
11. Kee-El Subdivision contains several small, permanently flooded impoundments within the subdivision. Pine Oak Creek runs through the subdivision.
12. Lake Bastrop Pines Subdivision lies approximately 1.3 miles south of Lake Bastrop. A small, permanently flooded impoundment lies on the adjacent property to the east.
13. Lake Thunderbird, a relatively large, permanently flooded impoundment, lies within the Thunderbird Lake Estates Subdivision. The lake is fed by a tributary of Gravelly Creek, which also runs through the subdivision. Two other smaller, permanently flooded impoundments lie less than one mile northeast of the subdivision. Several small, permanently flooded impoundments lie on adjacent properties. The Colorado River lies approximately 1.5 miles south of the Lake Thunderbird Estates Subdivision.
14. Lake View Estates Subdivision lies less than half a mile east of Lake Bastrop. It appears that no streams, creeks, or permanent ponds are located on the subject property.
15. Lincoln Lake, a relatively large, permanently flooded impoundment, lies within the Lincoln Lake Estates Subdivision. Long Branch Creek and Bluff Creek lie approximately 1.0 mile northwest and 1.4 miles east, respectively, from the subdivision. Several small, permanently flooded impoundments lie on adjacent properties.
16. Lost Pines Subdivision lies approximately 1.9 miles north of the Colorado River and approximately 0.76 miles east of Copperas Creek. It appears that at least one small, permanently flooded impoundment occurs on the property.
17. Lost Pines Park Subdivision lies approximately 3.0 miles northwest of the Colorado River. Alum Creek runs through the subdivision.
18. Mesa Pinto Subdivision lies approximately 1.0 mile east of the Colorado River. Several small, permanently flooded impoundments occur on the property.
19. The Milton Property Subdivision lies approximately 3.0 miles north of the Colorado River and less than 0.5 miles west of an unnamed, forested, temporarily flooded creek. It appears that several small, permanently flooded impoundments are located on the subject property.

20. The Ortiz Property Subdivision lies approximately 2.0 miles north of the Colorado River and less than 0.25 miles west of an unnamed, forested, temporarily flooded creek. It appears that no streams, creeks, or ponds are located on the subject property.
21. The Overlook Subdivision lies less than 0.5 miles north of the Colorado River and less than 1.0 mile west of an unnamed, forested, temporarily flooded creek. It appears that several small, permanently flooded impoundments are located on the subject property.
22. Park Hill Farms Subdivision lies approximately 1.5 miles north of the Colorado River and less than 0.5 miles west of Buescher Lake and Dry Branch Creek, which feeds Buescher Lake.
23. Pine Cove Estates Subdivision lies approximately 2.5 miles northeast of the Colorado River and approximately 0.5 miles west of Alum Creek. It appears that no creeks, streams, or permanent ponds are located on the subject property.
24. Pine Forest Subdivision (excluding Unit 6) lies approximately 1.0 mile north of the Colorado River. Copperas Creek lies less than 0.5 miles west of the subdivision. Several small, permanently flooded impoundments are located on the property.
25. Pine Forest Subdivision - Unit 6 lies approximately 2.5 miles southwest of Lake Bastrop and approximately 1.5 miles north of the Colorado River. Copperas Creek lies approximately 1.6 miles west of Unit 6 of the Pine Forest Subdivision. It appears that no creeks, streams, or permanent ponds are located on the subject property.
26. Pine Hill Estates Subdivision lies approximately 1.5 miles southeast of Lake Bastrop. It appears that no streams, creeks, or permanent ponds are located on the subject property.
27. Pine Junction North and South lies approximately 1.6 miles north of the Colorado River and less than 1.0 mile west of an unnamed, forested, temporarily flooded creek. It appears that no streams, creeks, or ponds are located on the subject property.
28. Pine Oak Estates Subdivision lies less than one mile east of the Colorado River. It appears that no creeks, streams, or permanent ponds are located on the subject property.
29. Pine Ridge Farms Subdivision lies approximately 4.4 miles east of Lake Bastrop. Little Alum Creek runs through the subdivision. Several small, permanently flooded impoundments also occur within the subdivision.
30. Pine Tree Cattle Ranch Subdivision lies approximately 2.3 miles west of Droemer Lake. An unnamed, forested, temporarily flooded creek runs through the northwest corner of the subdivision and Gravelly Creek lies less than 0.5 miles east of the subdivision. It appears

that at least one small, permanently flooded impoundment is located on the subject property.

31. Pine Valley Subdivision lies approximately 3.6 miles east of Lake Bastrop. Alum Creek runs through the subdivision. Several small, permanently flooded impoundments also occur within the subdivision.
32. Pine View Estates Subdivision lies less than 1.0 mile south of Lake Bastrop. A small, temporarily flooded impoundment which supports persistent emergent vegetation is located on the adjacent property to the northwest.
33. Pine Wood Subdivision lies approximately 2 miles northeast of the Colorado River and less than 1.0 mile west of Alum Creek. It appears that several small, permanently flooded impoundments are located on adjacent properties, but that no streams, creeks, or permanent ponds are located on the subject property.
34. Piney Ridge Subdivision lies approximately 1.3 miles southeast of Lake Bastrop. Piney Creek runs along the western border of the subdivision.
35. Pioneer Pines Farm Subdivision lies approximately 4.1 miles east of Lake Bastrop. Alum Creek runs through the subdivision.
36. Ponderosa Homestead Subdivision lies approximately 3.6 miles northeast of Lake Bastrop. Alum Creek runs through the subdivision. Several small, permanently flooded impoundments are located throughout the subdivision.
37. Scenic Farms Subdivision lies approximately 1.2 miles west of Rocky Creek, a temporarily flooded creek, and less than 0.3 miles south of several small, permanently and temporarily flooded impoundments located on adjacent properties. According to NWI maps, it appears that at least one small, permanently flooded impoundment is located on the subject property.
38. Smithville West Subdivision lies approximately 1.1 miles north of the Colorado River and approximately 0.3 miles west of an unnamed, forested, temporarily flooded creek. According to NWI maps, it appears that several small, permanently flooded impoundments are located on the subject property.
39. South Paige Estates Subdivision lies less than 1.0 mile southeast of Pine Oak Creek. Several small, permanently flooded impoundments are located on adjacent properties to the south. It appears that no streams, creeks, or permanent ponds occur on the subject property.
40. Spring Hollow Subdivision is approximately 1.9 miles north of the Colorado River and less than 0.25 miles west of an unnamed, forested, temporarily flooded creek. It appears that no streams, creeks, or ponds are located on the subject property.

41. The Tahitian Village Subdivision is bordered to the south by the Colorado River. Copperas Creek runs through the subdivision near the eastern border, and empties into the Colorado River. Several small, permanently flooded impoundments lie within the boundaries of the subdivision.
42. The Pinery Subdivision lies approximately 1.4 miles north of the Colorado River and less than 1.0 mile west of an unnamed, forested, temporarily flooded creek. It appears that several small, permanently flooded impoundments are located on the subject property.
43. The Pines of Alum Creek Subdivision lies approximately 2.5 miles northeast of the Colorado River and approximately 0.4 miles west of Alum Creek. It appears that at least one small, permanently flooded impoundment is located on the subject property.
44. Tonkawa Hills Subdivision lies approximately 1.5 miles southeast of Lake Bastrop. It appears that no streams, creeks, or permanent ponds are located on the subject property.
45. Turkey Run Subdivision lies approximately 3.0 miles northeast of the Colorado River and less than 1.0 mile east of JD Creek. It appears that no streams, creeks, or ponds are located on the subject property.
46. Whispering Pines Subdivision lies approximately 1.7 miles east of the Colorado River and less than 0.5 miles west of Little Alum Creek. Several small, permanently flooded impoundments are located on adjacent properties to the north and south. It appears that no creeks, streams, or permanent ponds are located on the subject property.

3.8 AIR QUALITY

Bastrop County and the City of Bastrop are currently full attainment areas for all air quality criteria pollutants of the U.S. Environmental Protection Agency (EPA) and Texas Natural Resource Conservation Commission (TNRCC). Changes in attainment standards could affect future attainment status.

3.9 WATER QUALITY

Water quality on the remaining undeveloped lots within the 46 subdivisions is estimated to be good as the land is currently undeveloped, with no commercial or residential use. The Colorado River and Lake Bastrop are listed as suitable for contact recreation by the TNRCC.

3.10 CULTURAL RESOURCES

The Service searched County records and the National Register of Historic Places National Register Information Systems website at www.nr.nps.gov. There are no properties or archeological sites listed on the National Register of Historic Places or with the Texas Historical Commission (THC) for the included subdivisions.

3.11 SOCIOECONOMIC

Bastrop County, in which the Subdivisions included in this EA/HCP occur, experienced steady growth in the 1990s. According to the U.S. Bureau of the Census, the current population change is estimated to be 3.2% per year. The current (1999) population for the county is estimated at 52,002, up from 38,263 in 1990. Assuming a constant annual 3.2% population increase, the projected population in 2010 will be 73,534.

Unemployment currently stands at 3.0%. Local government, real estate development, trade, and service are the primary employment sectors, according to the Bastrop Chamber of Commerce. Local economies are also largely supported by tourism, agriculture, and mineral production (Ramos 1997). The average income in the county is \$30,072; however, at least 38% of the population makes less than \$25,000/year (Bastrop County Chamber of Commerce).

Residential real estate trends have paralleled growth and employment statistics with 206 homes sold in the Bastrop area in 1997 at an average price of \$87,750. From January 1, 1999, to November 2, 1999, there were a total of 294 homes sold in the Bastrop area at an average price of \$110,370. Despite the fact that many of the subdivisions have been platted for 15-20 years, the oldest recorded in 1961, residential development within the 46 subject subdivisions currently stands at about 25% (3,133 developed lots ÷ 12,353 total lots). With the expansion of Austin, the opening of the Austin-Bergstrom International Airport (located about 20 miles west of Bastrop), the rising cost of real estate in areas outside of Bastrop, and the aesthetic appeal of the Lost Pines area, the Service, as well as long-time residents of Bastrop County, have recently witnessed a tremendous increase in residential development, a trend expected to continue into the future.

Rapid urban growth and development in the greater Austin area has contributed considerably to the increase in development in Bastrop County. With these prospective homeowners comes new housing developments, expanded infrastructure, and an increased tax base to Bastrop County. The subject lots are currently undeveloped, but with increased demands for housing and employment, the area is being pressured for suburban development.

4.0 ALTERNATIVES, INCLUDING THE PREFERRED ACTION

This section presents details of the preferred alternative and other alternatives that have been considered. The National Environmental Policy Act (NEPA) requires that federal agencies consider a range of alternatives that could reduce the environmental impacts of the particular projects under consideration. In addition, if wetlands or archeological sites or other resources protected under laws other than the Endangered Species Act are to be impacted, the Service will recommend to the Applicant that he/she apply for additional specific permitting under those other federal agencies and programs which have jurisdiction over permits, other than endangered species permits.

Residential lot owners in Bastrop County are faced with three choices if they wish to construct single-family residences or other similar structures and comply with the Act. They can: (1) comply with the Act by not clearing or constructing in Houston toad habitat; (2) comply with the

Act by developing individual HCPs in order to obtain endangered species permits prior to land clearing; or, (3) use the template HCP developed by the Service.

Each of these choices has its limitations. Landowners may continue to incur costs associated with ongoing property tax burdens while waiting to develop their lots. If the landowners decide to develop their lots and proceed with developing individual HCPs and obtaining endangered species permits for construction of their single-family residences or other similar structures, they often become discouraged with the complexity of the permitting process and the time delays associated with issuance of these traditional endangered species permits. Even with the Service's template HCP, the projected timeframe to customize each individual HCP prior to review, approval, and permit issuance may take from 4 to 6 months. These time delays and such a piecemeal approach also delay implementing conservation measures for the Houston toad, which are urgently needed for this imperiled species. Lot owners who choose to proceed with lot clearing and construction without an endangered species permit run the risk of non-compliance with the Act, which can result in fines and/or imprisonment. This latter situation places both the individual lot owners and the Service at considerable risk of litigation, while resulting in the ultimate demise of the Houston toad and its habitat.

In developing this EA/HCP, the Service considered the following three alternatives:

- 1) Preferred Alternative 1 - HCP covering construction and occupation of single-family residences or other similar structures on the remaining undeveloped lots in 46 existing subdivisions in Bastrop County, Texas;
- 2) Alternative 2 - Acquisition and preservation of remaining undeveloped lots within existing subdivisions; and,
- 3) Alternative 3 - No Action.

Environmental consequences of the various alternatives are presented in Section 5.0 of this EA/HCP.

4.1 ALTERNATIVE 1 - PREFERRED ACTION - HCP Covering Construction and Occupation of Single-Family Residences or Other Similar Structures on Remaining Undeveloped Lots in 46 Existing Subdivisions in Bastrop County, Texas

The preferred alternative is issuance of endangered species permits to individual lot owners under an revised EA/HCP with permit numbers TE-025965-1-X (low) and TE-025997-1-X (medium), where the permit issued to each individual landowner would authorize the take of the endangered Houston toad and the threatened bald eagle resulting from the construction and occupation of single-family residences or other similar structures on approximately 0.5 acres or less on an undeveloped lot anywhere in the 46 subdivisions covered under this EA/HCP. This revised EA/HCP would cover most forms of development, which will be at the Service's discretion, provided that the area of disturbance is approximately 0.5 acres or less. The 0.5-acre development area will include all development including the single-family residence or other similar structure, garage, yard, garden, pool, septic system, well, and any other associated

structures. The 0.5-acre delineation does not include the driveway, provided it is 16 feet wide or less. If the driveway is greater than 16 feet wide, it will be considered part of the 0.5-acre development area. The HCP is fully addressed in Section 6.0 of this EA/HCP.

This alternative was selected as the preferred alternative because it will allow for application for and responsible development of the remaining lots in these subdivisions while minimizing and offsetting potential impacts to the Houston toad and bald eagle. On-site conservation measures and off-site mitigation dollars remitted to the Houston Toad Fund specifically for acquisition, protection, and management of Houston toad habitat in Bastrop County are intended to promote the long-term survival of both species.

The preferred alternative also provides the most efficient and effective process by which landowners can obtain endangered species permits. The EA/HCP requires the same avoidance, minimization, and mitigation efforts from every lot owner who chooses this option (see Section 6.0 of this EA/HCP), which negates the need and associated costs (in both time and money) to prepare individual HCPs and go through separate public review processes. This EA/HCP will have already been completed, will cover all remaining undeveloped lots in the 46 listed subdivisions, and will have had public review and comment (through *Federal Register* notice). Thus the Service anticipates that in most cases endangered species permits could be issued in a matter of weeks, as opposed to the more burdensome timeframe that currently exists.

Approval and utilization of this preferred alternative would allow for immediate action along with immediate conservation measures for the Houston toad, the bald eagle, and the habitat upon which they depend. By minimizing the development area on each property/lot to approximately 0.5 acres and providing mitigation funding to protect and manage large areas of Lost Pines forest, build-out of the 46 subdivisions covered under this EA/HCP will help create a system of habitat preserves and corridors needed to promote and preserve viable Houston toad populations and benefit bald eagles that occur in the Lost Pines area. Simplifying and streamlining the endangered species permitting process is also expected to increase voluntary compliance with the Act. The option of this EA/HCP will thus provide both regulatory assurances for private landowners to move forward with construction of single-family residences or other similar structures and help protect the Houston toad, the Lost Pines forest, and the bald eagle in Bastrop County through conservation measures.

Under the EA/HCP, each individual lot owner will be responsible for applying for a permit and complying with the terms and conditions set forth in Section 6.0 of this EA/HCP document. A landowner who receives an endangered species permit under this EA/HCP will receive relief from further regulatory liability related to the Houston toad and bald eagle under the Act and be provided certainty that his/her construction project(s) can go forward in full compliance with the Act. Receipt of an endangered species permit under the Act does not relieve the landowner from liability relative to other required State and Federal permitting processes.

Permitting Process Under the Proposed EA/HCP

The Service anticipates the following process will occur.

The Landowner will:

- Complete an application form 3-200, which will also include: the property location and its subdivision, legal description, one plat map of each lot(s) under consideration, one map of the lot's location within Bastrop County, and a taxpayer ID #;
- Submit the application with a check for \$25 for endangered species permit processing;
- Commit to compliance with the terms and conditions of this EA/HCP, as described in Section 6 of this EA/HCP;
- Sign, date and notarize two copies of the Implementing Agreement for the particular permit in question (TE-025965-1-X (low) or TE-025997-1-X (medium)). Signing the Implementing Agreement commits the landowner to abide by and implement the conditions of the HCP.
- The Applicant will submit mitigation funding (check or money order made out to the National Fish and Wildlife Foundation with the permit number and REF # 98-245 written on it) to the Service prior to, or at the time of permit issuance. This funding will be used for acquisition of Houston toad habitat (Lost Pines forest) in Bastrop County. This acquisition will also benefit bald eagles that occur in the Lost Pines area.

The Service will:

- Review, approve, sign, and date the Implementing Agreement for the landowner;
- Assign endangered species permit #s TE-025965-1-X (low) or TE-025997-1-X (medium);
- Issue the endangered species permit to the Landowner to allow construction of a single-family residence or other similar structure to proceed (a separate permit number will be issued for each tract of land that will contain a single-family home or other similar structure);
- Forward mitigation payments to the National Fish and Wildlife Foundation;
- Monitor the subdivisions to ensure construction and occupation of single-family residences or other similar structure are proceeding according to the permit terms and conditions.

Figure 3: Location of the 4 subdivisions containing low quality Houston toad habitat, and location of Critical Habitat in Bastrop County, Texas

Figure 4: Location of the 42 subdivisions containing medium quality Houston toad habitat, and location of Critical Habitat in Bastrop County, Texas

Eligibility Requirements for Participation in the HCP

- This proposed EA/HCP is specifically for the remaining undeveloped legal lots, legal tracts, or single parcels of land in the 46 subdivisions (Figures 3 and 4; Tables 1 and 2) that were platted and partially developed on or before December 31, 1994. These 46 subdivisions include a total of approximately 12,353 lots that cover a total of 13,163 acres, of which approximately 9,220 undeveloped lots on a maximum of 6,609 acres of sub-optimal habitat remain. (Table 3). The year 1994 was chosen because it represents the year that the Service initiated public discussions with Bastrop County officials and citizens regarding the Houston toad. In 1994, the Service began outreach efforts with the public, including landowners, area builders, and real estate agents about the Houston toad and the endangered species permitting process.
- There are portions of seven subdivisions which contain areas that the Service believes do not contain Houston toad habitat and construction within these areas is not likely to result in an impact to the bald eagle (see Figures 5-10 for details of portions of the Tahitian Village and Pine Forest-Unit 6, Gravelly Oaks, Kee-El, Piney Ridge, Ponderosa Homestead, and Smithville West subdivisions). Unless new information suggests otherwise, these specifically noted areas in Figures 5, 6, 7, 8, 9, and 10, are exempt from the permitting requirements. Development within the designated portions of these subdivisions is not anticipated to cause “take”. Therefore, no endangered species permit is needed and participation in this process is currently not necessary.
- This EA/HCP does not limit the number of lots that may be included in any one application, the number of individuals applying for an endangered species permit, or the number of times an individual may apply for an endangered species permit, so long as these applications relate directly to development of one single-family residence or other similar structure each, within the subdivision development area to which this EA/HCP applies, and include the proper mitigation fee(s). Thus, a lot owner who agrees to comply with the terms and conditions set forth in this EA/HCP could potentially hold one or multiple permits for construction of single-family residences or other similar structures on properties at one or more of the 46 specific subdivisions.
- The Service will review applications for construction on lots re-subdivided on or after January 1, 1995, on a case by case basis to determine whether or not the construction increases the extent of take as defined in Section 5.1.1.3 of this EA/HCP. If the Service determines that construction on the re-subdivided lot will not increase the extent of take overall, then the Applicant can be approved to participate under this EA/HCP.
- No owners of lots other than those in the subdivisions specifically named herein are eligible to participate under this EA/HCP.

Figure 5: Area outside designated Critical Habitat or area not considered Houston toad habitat in Tahitian Village and Pine Forest - Unit 6, Bastrop County, Texas

Figure 6: Area not considered Houston toad habitat in the Gravelly Oaks Subdivision, Bastrop County, Texas

Figure 7: Area not considered Houston toad habitat in the Kee-El Subdivision, Bastrop County, Texas

Figure 8: Area not considered Houston toad habitat in the Piney Ridge Subdivision, Bastrop County, Texas

Figure 9: Area not considered Houston toad habitat in the Ponderosa Homestead Subdivision, Bastrop County, Texas

Figure 10: Area not considered Houston toad habitat in the Smithville West Subdivision, Bastrop County, Texas

- Any applicant who wishes to deviate from the scope, terms, and conditions described herein will not qualify under this EA/HCP.
- Endangered species permits cover impacts to listed species that are reasonably expected to occur, are incidental to otherwise lawful activity, and are not retroactive. Lots that have already been developed without an endangered species permit are not eligible for coverage under this EA/HCP and are not afforded regulatory assurances under the Act.

Endangered species permits may be issued under these 46 Subdivisions EA/HCP permit numbers TE-025965-1-X (low) and TE-025997-1-X (medium) for either: (1) a period of 5 years from date of issuance of the first permit and first signed Implementing Agreement under this EA/HCP; or (2) until complete build-out of the 46 subdivisions occurs; or (3) until a Bastrop area HCP for Bastrop County has been approved and permitted, whichever comes first. If the five-year period comes first, the Service will review the outcome of the HCP to determine if it should be terminated, extended, or modified. Permits issued to individual landowners will be valid for a period of five years from the date their permit is issued.

The Service encourages the incorporation of this HCP into a broader, Bastrop area HCP, which may occur at any time. The Service believes a Bastrop area HCP in Bastrop County would do the most to protect the Houston toad and its habitat in the long-term. However, until the Bastrop area HCP is in place, this EA/HCP provides a mechanism to issue endangered species permits in an efficient, expeditious, and effective way. If, at the end of the five-year period, the Service determines that it is prudent to extend or modify the HCP, or a Bastrop area HCP is approved and permitted prior to that time, additional opportunities for public review and comment will be provided. Anticipated on-site and off-site impacts of the proposed action are addressed in Section 5.1 of this EA/HCP.

4.2 ALTERNATIVE 2 – ACQUISITION AND PRESERVATION OF REMAINING LOTS

This Alternative proposes the acquisition and preservation of remaining habitat within the 46 subdivisions to which this EA/HCP applies. Fundamental tenets of conservation biology include protecting large blocks of high quality, and interconnected habitat. Although the 46 subdivisions contain habitat suitable for the Houston toad, ensuring long-term conservation of large blocks of Lost Pines forest is a higher priority (a single large preserve is biologically more stable than an equivalent number of acres spread out in several small preserves) and less expensive (estimated \$2,000/acre) than acquiring lower quality, small habitat acreage within the subdivisions (estimated at \$20,000/lot or more). The high costs associated with acquisition, habitat restoration, and management of these subdivision lots are not economically viable. Displacement from the existing subdivisions could also encourage development to move into the remaining high quality habitat areas, which are not part of the EA/HCP. Thus, this Alternative was rejected from further consideration. Instead, the Service believes the most feasible alternative is to encourage landowners to maintain enough habitat on-site within the 46 subdivisions (Tables 1 and 2), so that dispersal via habitat connections can continue to occur from, between, and among, the larger, higher quality habitat sites.

4.3 ALTERNATIVE 3 – NO ACTION

This Alternative assumes either: (1) that the option of issuing endangered species permits under this 46-Subdivisions HCP permit number would not be made available to individual lot owners, and landowners would need to continue to individually develop HCPs; or, (2) no permits for incidental take of Houston toads or bald eagles would be issued. Under the first assumption, Applicants would not be able to apply for permits under this 46-Subdivisions EA/HCP and permit issuance for development within these subdivisions would continue to proceed under the standard inefficient process. Due to the additional time delays, take of Houston toads and bald eagles would likely increase if landowners in these subdivisions decided to risk liability under the Act and construct single-family residences or other similar structures without recommended measures to avoid, minimize, and mitigate for take of the Houston toad and bald eagle. Abandonment of proposed single-family residence or other similar structure projects would also result in the loss of significant monies invested in properties and project plans, and cause economic loss to the landowner. Under both assumptions, although some properties would remain in their natural vegetational states, indirect take would likely occur as a result of development on adjacent properties or as a result of unpermitted development. Houston toads in the vicinity of the developed properties could be displaced as a result of increased competition with species such as Woodhouse's toad and the Gulf Coast toad, predation by urban adapted predators, such as dogs, cats, and raccoons, and roadway mortality, as well as the introduction of exotic turf-grasses (and increased application of pesticides) that can limit and decrease Houston toad mobility and dispersal. These factors would work together to fragment habitat and thus decrease the numbers and distribution of toad populations. Additional harassment of bald eagles is also anticipated under this alternative. In addition, no areas would have any active management for endangered species and there would be no effective provision of land or money for permanent habitat protection for the Houston toad and bald eagle in Bastrop County. Therefore, this Alternative was rejected.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 ALTERNATIVE 1 - PREFERRED ALTERNATIVE

5.1.1 On-site Impacts

5.1.1.1 Vegetation

Development within these 46 subdivisions will result in surface and/or vegetational alteration of approximately 0.5 acres or less per eligible lot(s). Most vegetative resources within these 0.5-acre development areas will be altered. The remaining portions of each lot/property will be left in their natural states. Overall, up to a maximum of approximately 4,610 acres (9,220 undeveloped lots x 0.5-acre development area per lot) of Houston toad habitat could be directly impacted as a result of complete build-out within the 46 subject subdivisions (Table 3). This is approximately 9% of the 50,000 acres that have already been platted for single-family development or are sub-optimal habitat areas due to agricultural and other uses.

5.1.1.2 Wildlife

Wildlife within those areas planned for development will largely be displaced to adjacent areas during construction. Following construction, landscape vegetation and preserved trees could provide habitat for those species tolerant of suburban development. Direct and indirect effects of development on the properties may result in slight negative or positive impacts to the populations of those species that are either tolerant or intolerant of human intrusion within the area. For example, snake and other native herpetofaunal species and invertebrates are likely to decrease, which may be due to human presence and an increase in detrimental edge effects. Populations of deer, racoons, and opossums are likely to increase because of the increased availability of food for them near proposed development areas and their greater tolerance for human disturbance. In addition, human disturbance has the potential for contributing to increased fire ant populations associated with disturbed areas.

5.1.1.3 Listed, Proposed, and Candidate Species

The Houston toad is considered likely to occur and be impacted by the proposed activity. Habitat within these subdivisions is considered sub-optimal because of the level of existing development, including roadways, utilities, and houses. However, Houston toads are still expected to occur in low numbers throughout the areas included in this EA/HCP. Houston toads have been sighted or heard within or adjacent to most of or at least portions of the 46 subdivisions. Some subdivisions included in this EA/HCP have not had any documented occurrences of Houston toads. This is likely due to the lack of surveys within them. However, habitat analysis indicates Houston toads are likely to occur to some extent in all of the subdivisions included in this EA/HCP (USFWS 1994). Although Houston toads can only reliably be found by listening for toad choruses during the breeding season, toads are known to travel approximately 1.0 mile from breeding sites (Price 1992) and forage across the landscape, further increasing the likelihood of toad occurrences within all the subdivisions.

It is anticipated that construction and subsequent habitation of each lot included in this EA/HCP will result in take of the Houston toad, directly and indirectly. Construction within the subdivisions is likely to result in direct impacts resulting in take of toads or direct alteration of habitat used for breeding and foraging. The increasing density of human habitation increases the chances of encountering Houston toads and increases the potential for humans trapping, capturing, and/or collecting toads, and either accidentally or intentionally wounding or killing toads. Malicious killing of other toad species has been documented in some residential areas.

The construction of each single-family residence or other similar structure and associated infrastructure will also result in permanent habitat loss and fragmentation. Direct mortality of toads may occur during site clearing, preparation, and construction. Indirect impacts may include: the replacement of native vegetation with exotic species or sod-forming grasses which inhibit the toad's ability to burrow and disperse; an increase in habitat fragmentation which increases the proliferation of competitive or predatory species; and an increase in the number of roadways and levels of traffic which could inhibit the toad's movement, resulting in additional vehicle strikes and potential genetic isolation.

Since bald eagles are a rare to uncommon winter resident in the Lost Pines area (Freeman 1996), the potential for on-site impacts in the form of harassment is possible. Harassment is defined by regulation as “an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering.” Harassment may include increased noise or human activities that disturb roosting bald eagles.

Assessment of Take

The factors addressed in Section 3.3 of this EA/HCP were considered in determining the extent of take from development in these subdivisions. The majority of the survey data collected for the Houston toad in Bastrop County indicates only the presence or absence of the species only during the breeding season, and not population density. This take analysis is based on the best available information regarding population distribution of breeding Houston toads in Bastrop County. Since only the breeding distribution in Bastrop County is known, and not population size or non-breeding distribution, the Service is unable to estimate the number of Houston toads that will be impacted due to the proposed action. However, approximately 0.5 acres or less of Houston toad habitat and any Houston toads located within each 0.5-acre development area are expected to be directly impacted by the proposed action. Overall, up to a maximum of approximately 4,610 acres (9,220 undeveloped lots x 0.5-acre development area per lot) of Houston toad habitat could be directly impacted as a result of complete build-out within the 46 subject subdivisions (Table 3). This is approximately 9% of the 50,000 acres that have already been degraded due to existing development or approximately 4% of the 108,500-acre area that contains known and potential habitat, including Critical Habitat, for the Houston toad. If, over the next 5 years, 100% build-out of the 46 subdivisions occurs, which is unlikely, there would be a loss of approximately 25% of the degraded habitat. In addition, indirect impacts (as described in Sections 3.3 and 5.1.1.3 of this EA/HCP) are expected to occur within the confines of each lot within the 46 subdivisions as a result of the proposed developments.

Since bald eagles are a rare to uncommon winter resident of the Lost Pines area (Freeman 1996) and are known to nest along the Colorado River and its tributaries, the potential for on-site, off-site, and cumulative impacts in the form of harassment is possible (see sections 5.1.1.3, 5.1.2.3, and 5.1.3.3). Based on Freeman’s (1996) definitions of rare (one to several per season) and uncommon (less than 5 per day), combined on-site, off-site, and cumulative impacts are not anticipated to impact more than 5 bald eagles for the duration of this HCP.

No take is anticipated for any other federally listed or proposed species.

Under the original 46 Subdivision EA/HCP, from April, 2000 to February, 2001, the Service received and processed, or is currently processing 83 applications within the subject subdivisions. Based on data from these 10 months, approximately 100 permits could be issued under this HCP per year, with a total estimated 500 permits over the five-year duration of this revised EA/HCP. Based on numerous conversations with Bastrop County residents, many small landowners are currently hindered by the 4 to 6-month period required to apply for and obtain an endangered species permit. In many cases, these landowners feel that they have no other options but to continue with their construction plans and risk potential violation under the Act. Since this HCP is expected to make the permit process more efficient and expeditious for landowners

proposing to construct single-family residences or other similar structures within the 46 subject subdivisions, landowner participation is expected to increase under this HCP. The Service estimates that up to 9,220 landowners, covering a maximum of 4,610 acres of development (9,220 undeveloped lots x 0.5-acre development area per lot) (Table 3) could be served by this EA/HCP. However, the actual number of permits issued under this EA/HCP will depend on the level of population increase in Bastrop County and the number of applications received before the HCP expires or Bastrop County implements a Bastrop area HCP, whichever comes first.

Although habitat quality within the 46 subdivisions is sub-optimal, the Service believes that on- and off-site conservation measures within these areas will help toward the preservation of large, contiguous blocks of habitat and the migration corridors connecting them which are important to the long-term conservation and survival of the Houston toad.

As part of the proposed action, an HCP has been developed to mitigate for and minimize the potential negative impacts described above and assure that this action does not reduce the potential for survival of the Houston toad in the wild, as mandated by requirements of 50 CFR Part 17.22(b)(1)(iii). The HCP is detailed in Section 6.0 of this EA/HCP.

5.1.1.4 Wetlands

Areas subject to jurisdiction under Section 404 of the Clean Water Act include those areas that fall at or below the “plane of ordinary high water” of these waterways as defined by 33 CFR 323.2. Some areas within the subject tracts may be identified as wetlands. If wetlands are to be impacted, the Service will recommend to the Applicant that he/she apply for a permit through the U.S. Corps of Engineers and work to ensure these impacts to wetlands are avoided, minimized, and mitigated. Run-off into this area is to be treated according to local regulations and EPA standards for non-point source pollution and sedimentation prevention. Ephemeral (temporary) wetlands, which are often too small to be identified on NWI maps and may not be regulated by the Corps of Engineers, could exist on some of the properties. It is likely that some of these wetlands will be filled in on some of the 0.5 acre homesites development areas, but will persist on undeveloped portions of these lots.

5.1.1.5 Soils/Geologic Formations

No substantial geologic alterations are anticipated from the proposed project. Some surface soil alterations will result from trenching for septic system installation and some compaction will result from construction. Imported top soil and fill for the construction of a house and yard will be limited to a maximum of 0.5 acres per development area.

5.1.1.6 Land Use

The subdivisions will be converted from partially undeveloped to developed with single-family residences or other similar structures and associated infrastructure. The proposed developments are fully comparable and compatible with current land uses in the area. Since the permit under this EA/HCP only covers existing subdivisions which were legally platted on or before December 31, 1994, development of these properties is not anticipated to greatly increase the

overall level of development in the area beyond that currently existing, platted, or planned (See Table 3).

5.1.1.7 Water Resources

Subsurface groundwater resources will be slightly altered by construction of impervious cover in the form of single-family residences or other similar structures and driveways. Water that would have seeped into geologic strata will become surface run-off. There could also be increases in sediment loading and other pollutants in surface water run-off. In addition, water withdrawal from these groundwater resources is expected to increase from additional families moving into the area.

Impervious cover will be increased by the construction of each single family residence or other similar structure. The remainder of each property will be maintained in its natural vegetational state, allowing some level of continued filtration of surface run-off and subsurface recharge into geologic strata.

5.1.1.8 Air Quality

Bastrop County and the City of Bastrop are currently in full attainment areas for all air quality criteria pollutants of the EPA and TNRCC. Development of the subdivisions will contribute to local traffic noise and exhaust emissions by increasing the number of people operating vehicles in the area. A slight reduction in the number of trees on the properties may slightly reduce local air filtering capabilities, although this reduction may be offset by future native vegetation landscaping. A temporary increase in noise and dust levels is expected during construction processes.

5.1.1.9 Water Quality

No substantial impacts are expected to occur from run-off of the newly developed areas. All development codes, current or future, are expected to be complied with during all aspects of development. Some water quality degradation may occur from potential pesticide and fertilizer use on the developed areas, but use of these is restricted in the terms and conditions required by the EA/HCP.

5.1.1.10 Cultural Resources

There are no properties or archeological sites listed on the National Register of Historic Places or with the THC for the developed areas. No impacts are expected to occur to any sites of historical value.

5.1.1.11 Socioeconomic Environment

The proposed development will result in additional residences and similar structures in the area. This will result in an increase in population and property values. The Service estimates that up to 9,220 landowners, covering a maximum of 4,610 acres of development (9,220 undeveloped lots x 0.5-acre development area per lot) (Table 3) could be served by this EA/HCP. However, the actual number of single-family residences and similar structures constructed will depend on the level of population increases in Bastrop County during the next 5 years.

5.1.2 Off-site Impacts

5.1.2.1 Vegetation

Slight vegetation alterations may result due to the introduction and spread of exotic species from the subdivisions. The impacts associated with the spread of exotic species is species-dependent and therefore unknown at this time. To minimize the risk of introduction and spread of exotic species, the Applicants shall only use vegetation native to Bastrop County outside of the homesite area (see Section 6.0 of this EA/HCP).

5.1.2.2 Wildlife

Displacement of wildlife to adjacent areas is anticipated through increased competition, exposure to predation, and an increase in species, both native and non-native, that benefit from suburbanization (fire ants, racoons, opossums, house cats, and dogs). Other impacts including increased mortality of wildlife due to vehicular strikes off-site are also anticipated to increase.

5.1.2.3 Listed, Proposed, and Candidate Species

Houston toads in the vicinity of the subdivisions may be killed or displaced as a result of increased competition, predation, and roadway mortality. Habitat fragmentation or alteration may increase hybridization with competitive species such as Woodhouse's toad and the Gulf Coast toad and allow the proliferation of fire ants in areas that have been cleared or otherwise disturbed. The addition of each single-family residence or other similar structure in the 46 subdivisions is likely to result in increased predation by suburban adapted predators such as dogs, cats, and racoons. Alteration of native vegetation may also result in the introduction and proliferation of exotic plant species. In addition, increases in the level of development will result in greater demands for an increase in the number of roads and cars, which increase the risk of mortality and create barriers to migration.

Since bald eagles are a rare to uncommon winter resident in the Lost Pines area (Freeman 1996), offsite impacts in the form of harassment, such as noise generated from the 46 subdivisions and increased recreational use of lakes and the Colorado River, are possible.

Implementation of conservation measures described in Section 6.0 of this EA/HCP illustrates methods to be used to minimize and mitigate potential on-site and off-site impacts to the Houston toad and bald eagle. Actions described for conservation/mitigation measures will address impacts that may result due to the proposed development.

5.1.2.4 Wetlands

Development of lots in these specific subdivisions is expected to result in a slight increase in sediment loading into receiving drainages and streams. All construction will comply with applicable construction codes for erosion and sedimentation control. To further minimize impacts to off-site wetlands, Applicants shall limit use of construction equipment to the development area and implement erosion control measures as necessary to prevent soil erosion and runoff. Also, the removal of trees and other native vegetation is limited to the development area, therefore allowing the remainder of each property to trap and stabilize sediments and other particles in surface runoff before they reach other wetlands (see Section 6.0 of this EA/HCP).

5.1.2.5 Soils/Geologic Formations

No appreciable off-site impacts to soils or geologic formations are expected to occur as a result of the proposed action.

5.1.2.6 Land Use

Development of the subdivisions will contribute to an increased demand for infrastructure improvements such as power lines, water and sewer lines, and road improvements, as well as the construction of stores, gas stations, and other similar urban development. Residential development within the subdivisions is fully comparable to current land use in the area.

5.1.2.7 Water Resources

Off-site surface and groundwater resources are not expected to be greatly impacted by these proposed activities. Since activities that would impact water resources on-site are restricted under the terms and conditions of this EA/HCP, natural water volumes exiting from the sites are expected to remain consistent with normal weather patterns with slight increases in surface water run-off due to increases in impervious cover. Additional demands on groundwater resources are expected, and could impact the amount of water in, and recharge of, the Carrizo-Wilcox Aquifer.

5.1.2.8 Air Quality

Vehicle emissions and noise levels are expected to increase locally due to an increase in the number of vehicles and residences in the areas. As growth increases, Bastrop County may need to implement air quality standards and consider alternative forms of transportation and/or fuels in order to ensure that growth does not impact regional air quality.

5.1.2.9 Water Quality

The use of pesticides and fertilizers within the subdivisions could lead to a decrease in the water quality of surface run-off and groundwater in the area adjacent to the subdivisions. Incidences of

spilled oil or other non-point source pollutants could contribute to decreased water quality as well. Since all construction will comply with applicable construction codes for erosion and sedimentation control, no appreciable off-site impacts from sediment run-off during construction are expected to occur.

5.1.2.10 Cultural Resources

No off-site impacts to cultural resources are expected.

5.1.2.11 Socioeconomic Environment

Development of the subdivisions is expected to result in an increase in the number of motorized vehicles in the area, which will result in increased traffic congestion and a decrease in local air quality. It will also result in an increase in the local human population, local property values, demand for public services (roads, schools, and utilities), as well as commercial services (gas stations and stores). The level of population increase in Bastrop County and the number of landowners who construct single-family residences or other similar structures will determine the environmental effects off-site of the 46 subdivisions.

5.1.3 Cumulative Impacts Analysis

This section considers the incremental environmental impact or effect of the action together with impacts of past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions.

5.1.3.1 Vegetation

The proposed developments will result in the disturbance and reduction of vegetation on no more than 0.5 acres (or less) per development area. The vegetation in the project areas consists primarily of loblolly pine, oaks, and bunch-grasses. This could cumulatively contribute to loss of this vegetation type in Bastrop County resulting from development, road construction, and other land use projects. It could also contribute to the cumulative increase in the number of exotic plant species.

5.1.3.2 Wildlife

The proposed development will, over time, contribute to a cumulative reduction of habitat for some wildlife species when added to impacts resulting from other development, road construction, and other land use projects in Bastrop County. Wildlife species associated with urban and suburban settings would likely increase, while species intolerant of development would locally decrease.

5.1.3.3 Listed, Proposed, and Candidate Species

The U.S. Census Bureau currently estimates that the human population of Bastrop County will increase by 3.2% annually. This increase in population and real estate activities has been

attributed to the expansion of Austin, the opening of the Austin-Bergstrom International Airport (located about 20 miles west of Bastrop), and the aesthetic appeal of the area. Over time, beyond the 5 year limitation placed on this HCP, without the safeguards of a county-wide plan, the cumulative impacts of an increasing human population are likely to negatively impact the Houston toad by reducing and fragmenting the amount of available habitat and increasing toad mortality.

The Houston toad thrives in large blocks of habitat where urban disturbance is minimal. The preferred alternative will directly reduce the amount of available habitat and contribute to further overall habitat fragmentation occurring in the area. This Preferred Alternative will contribute to the total take of Houston toads and/or the destruction of their habitat in Bastrop County when added to other endangered species permits that have been or will be issued by the Service. As of February 20, 2001 the Service is processing thirty (30) permit applications for the incidental take of the Houston toad that are not covered under the existing 46 Subdivision EA/HCP. These applications or pre-application consultations that are not covered under the existing 46 Subdivision EA/HCP are for both single and multiple lots and cover in excess of 570 acres of Houston toad habitat. To date, the Service estimates that throughout Bastrop County approximately 50,000 acres of potential Houston toad habitat is considered sub-optimal because of past land practices, of which the 46 subject subdivisions total approximately 13,163 acres. Approximately 58,500 acres of relatively unaltered woodland remains.

Unrestricted, uncontrolled residential development can cause habitat fragmentation and leave small, isolated woodlands that are partially or completely surrounded by roads, homes, and people. The best available information indicates that this increases the exposure and vulnerability of the Houston toad to development-related impacts such as cars, pets, construction activities, inter-specific competition, and predation. The Service believes that on- and off-site conservation measures within the 46 subdivisions to which this EA/HCP applies will help toward the preservation of large, contiguous blocks of habitat and the migration corridors connecting them which are important to the long-term conservation, survival, and recovery of the Houston toad.

With the successful implementation of recovery programs for the bald eagle, the potential exists for bald eagle populations to expand. The conservation measures identified under this preferred alternative would contribute to recovery efforts for the bald eagle by minimizing the extent of on-site disturbance, limiting the use of pesticides, and protecting large areas of Lost Pines forest. However, impacts to bald eagles in the form of harassment are possible. Based on Freeman's (1996) definitions of rare (one to several per season) and uncommon (less than 5 per day), the combined on-site, off-site, and cumulative effects of harassment are not anticipated to impact more than 5 bald eagles for the duration of this HCP.

5.1.3.4 Wetlands

The proposed action will cumulatively contribute to some level of degradation of wetlands within Bastrop County. No consequential impacts are expected.

5.1.3.5 Soils/Geologic Formations

No appreciable cumulative impacts to soils or geologic formations will occur as a result of the Preferred Alternative.

5.1.3.6 Land Use

Bastrop County has seen an appreciable increase in its population (Texas State Data Center 1996, 2000), due in part to recent population increases in the Austin area. This trend is expected to continue (Texas State Data Center 1996, 2000). The Preferred Alternative could contribute to the ongoing conversion of undeveloped land into developed land in Bastrop County. Past, present, and future developments must comply with all development codes.

5.1.3.7 Water Resources

According to Dalton (1999), between 1951 and 1996, groundwater pumpage from the Carrizo-Wilcox aquifer, one of Texas' major aquifer systems and the primary aquifer in Bastrop County, increased from approximately 10,600 to 37,900 acre-feet per year in the area between the Colorado River and the Brazos River. The construction of these residences and similar structures, combined with the projected population increase (Texas State Data Center 2000) will cumulatively result in additional demands on this and other local water supply/resources. A water management plan is currently being reviewed by the Texas Water Development Board addressing the issue of long-term effects of population growth and subsequent water consumption in the region.

5.1.3.8 Air Quality

The Preferred Alternative will contribute to degradation of air quality in Bastrop County, primarily through an increase in automobile emissions. The implication of the impact will depend upon air quality requirements for construction activities and automobiles. The continued development of the area could, over time, result in an appreciable cumulative impact on air quality.

5.1.3.9 Water Quality

As development increases in Bastrop County, the use of pesticides and fertilizers and the amount of impervious cover may result in degradation of surface and ground water quality. Incidences of spilled oil or other non-point source pollutants could contribute to decreased water quality as well. To minimize impervious cover and reduce contamination of surface runoff, each development area will be limited to 0.5 acres, erosion control measures will be implemented, and pesticides and fertilizers will be limited to the development area.

5.1.3.10 Cultural Resources

This project, because of its limited scope within already disturbed and platted subdivisions (where no recorded sites exist), and the nature of land disturbance associated with constructing

these single-family residences and similar structures, will not result in cumulative impacts to sites eligible for the National Register of Historic Places.

5.1.3.11 Socioeconomic Environment

The proposed project will cumulatively contribute to an increase in the local population and an increase in the level of urbanization with such things as additional roads, schools, stores, businesses, and traffic.

5.2 ALTERNATIVE 2 – ACQUISITION AND PRESERVATION OF REMAINING LOTS

Under this Alternative, small acreages of habitat remaining on undeveloped lots in the 46 subdivisions would be acquired and protected. Therefore, little or no further development in these subdivisions would be conducted. No additional on-site, off-site, and/or cumulative impacts within these subdivisions would occur.

However, this alternative could encourage development to move into adjacent areas of higher quality habitat, which would result in on-site, off-site, and cumulative impacts as described below. Alternative 2 could result in impacts to vegetation due to the increased need for new roadways and utilities into areas that had not been previously disturbed. This also would, in turn, change plant and wildlife species composition, increase mortality of plant and animal species, and decrease or alter vegetative cover in a detrimental manner.

The impacts to the Houston toad and bald eagle would be much greater. Large contiguous blocks of optimal habitat, which are biologically more stable than the remaining subdivision lots, would be more susceptible to development. Instead of facilitating build-out of existing subdivisions, this Alternative would encourage the destruction and degradation of remaining Houston toad habitat as well as bald eagle habitat.

The Service estimates that throughout Bastrop County approximately 50,000 acres of potential Houston toad habitat has been disturbed by both residential and commercial development and conversion for agricultural production. Approximately 58,500 acres of relatively unaltered, high quality woodland remain. Acquisition and preservation of the remaining undeveloped lots within the 46 subject subdivisions would leave little or no resources available to protect the 58,500 acres of unaltered woodlands, allowing it to become fragmented and sub-optimal habitat for Houston toads.

For these reasons, and for those discussed previously in Section 4.2, this Alternative is not biologically or economically feasible, and would result in greater impacts on the Houston toad. Therefore, it was rejected.

5.3 ALTERNATIVE 3 - NO ACTION

This Alternative is the current development scenario for Bastrop County. Development within the subdivisions would continue to proceed as it has in the past which would result in

environmental impacts that are similar to those listed in Alternative 1. However, this Alternative has shown that many individual landowners are not coming forward to apply for individual endangered species permits, nor are they, without permits, being educated about or committing to conservation measures and mitigation for impacts to Houston toads and bald eagles. The Service believes that these landowners are not applying for endangered species permits because of the significant time delays in issuing these permits, the cost and excessive paperwork associated with the permitting process, and because many continue to believe that they do not currently have liability under the Act.

Those landowners that are making a commitment and coming to the Service are under time constraints for construction, and the delays associated with waiting for processing, review, and approval of their HCPs are frustrating at best. The Service is itself under extreme pressure to help develop and process these individual applications and EA/HCPs for individual landowners, and the process is inefficient and makes adequate tracking and monitoring of the projects difficult. Each landowner who elects to participate is learning about the Houston toad, the bald eagle, and their habitat needs, as well as minimizing impacts and providing mitigation funds for Bastrop County Houston toad habitat acquisition and management in Bastrop County. Thus, although monies, minimization, and public education are part of this process, this Alternative was rejected as being cumbersome to private landowners and the Service, and of less value to the Houston toad and the bald eagle than the Preferred Alternative.

6.0 HABITAT CONSERVATION PLAN

This section contains the specific proposed conservation measures required for construction and occupation of a single-family residence or other similar structure on one or more lots within the 46 subdivisions in Bastrop County. This HCP is provided to minimize and mitigate any potential impacts to the endangered Houston toad and threatened bald eagle, while still providing the most efficient, effective, and least expensive way for a landowner, wishing to construct a single-family residence or other similar structure, to obtain an endangered species permit. It promotes on-site habitat protection to help maintain connectivity and dispersal corridors between large blocks of Lost Pines forest, as well as mitigation funding to help conserve large, contiguous remnants of the Lost Pines. As mandated by requirements of 50 CFR Part 17.22(b)(1)(iii), the Preferred Alternative is intended to ensure that the proposed developments do not reduce the potential for survival and recovery of the Houston toad or bald eagle in the wild. Although this HCP does not include any provisions for other listed or non-listed species, a number of other species, as noted in Sections 3.2 and 3.3 of this EA/HCP, are likely to benefit from the conservation of the Lost Pines forest.

This HCP is divided into two sections: (1) the first section includes 4 subdivisions the Service currently believes contains low quality habitat, that will provide very little, if any benefit to the Houston toad after it has been built-out (Tables 1 and 3), and (2) the second section includes 42 subdivisions the Service currently believes contain medium quality habitat that will provide some benefit to the Houston toad even after the subdivisions have been built-out (Tables 2 and 3). By maintaining habitat on-site, it is anticipated that even if complete build-out were to occur over the next five years, these subdivisions will provide possible migration corridors needed to

connect larger blocks of high quality preserved habitat. Initial development and continued occupation of the subdivisions in low quality habitat are expected to have less of an impact than the medium quality habitat subdivisions. Applicants wishing to develop within any of these 46 subdivisions will be required to comply with the terms and conditions listed under their respective sections (low or medium quality habitat subdivision).

Biological Goals

The goals of this HCP are to: 1) contribute in perpetuity to the protection and preservation of the Houston toad, bald eagle, and the Lost Pines forest on which they depend; 2) mitigate for the anticipated negative effects of constructing single-family residences or other similar structures in, and adjacent to, currently occupied Houston toad habitat; 3) contribute to the long-term survival of the Houston toad by preserving and maintaining enough habitat on-site to provide connectivity and dispersal corridors between remaining habitat blocks; 4) provide funds for acquisition and management of Houston toad habitat in Bastrop County, Texas; and 5) minimize and mitigate impacts to the bald eagle.

Terms and Conditions for the 4 Subdivisions in Low Quality Habitat (Table 1)

The following measures are proposed to minimize and mitigate for impacts to the Houston toad and bald eagle for the construction and occupation of each single-family residence or other similar structure and their associated buildings and infrastructure on the remaining undeveloped lots within the four (4) low quality habitat subdivisions to which this EA/HCP applies in Bastrop County:

1. Each single-family residence or other similar structure, associated buildings, and infrastructure will cover approximately 0.5 acres or less of the total property acreage. This 0.5-acre delineation does not include the driveway, provided it is less than 16 feet wide. If the driveway is greater than 16 feet wide, it will be considered part of the 0.5-acre development area. The remainder of the property shall be maintained in its natural vegetational state. Clearing during pre-construction and construction of any single-family residence or other similar structure will be limited to the 0.5-acre development area.

Woodland habitat is essential to provide cover, food, and shelter for the Houston toad. Minimizing habitat loss and fragmentation within the subdivisions and providing connectivity and dispersal corridors between large, contiguous blocks of woodland habitat are important to the toad's continued survival. In east Texas, bald eagles are also known to roost and forage in pine woodlands. Bald eagles are a rare to uncommon winter resident in the Lost Pines forest.

2. Use of construction equipment will be limited to the approximately 0.5-acre development area, and erosion control measures will be implemented as necessary to prevent soil erosion and run-off from the property.

Minimizing the area impacted during construction reduces the level of destruction and fragmentation within Houston toad and bald eagle habitat, as well as within the Lost Pines ecosystem. Use of erosion control measures aids in the protection of water quality within the area surrounding the development area.

3. The Permittee shall avoid or minimize use of herbicides and pesticides. If these products are used at all, they must be applied in full compliance with label guidelines for dilution and application. If the Permittee determines that an insecticide or herbicide treatment must be used, he/she must avoid contamination of temporary ponds and other natural wetlands or bogs by limiting use of chemicals near them and by disposing of rinse water and empty containers in strict accordance with label directions.

Amphibians are very sensitive to many contaminants, including pesticides and other organic compounds. These chemicals may affect the toad directly or indirectly, by affecting the toad through skin absorption, ingestion, inhalation, or by lowering the abundance and diversity of its food supply. Certain pesticides are also a known threat to bald eagles.

4. No logging, cutting of trees, or removal of vegetation shall be done outside of the approximately 0.5-acre development area, with the exception of dead, dying, or diseased trees or tree limbs which may be removed if the Permittee desires. Also, if the Permittee desires, common understory plants including yaupon, mesquite, and eastern red cedar found on the property may be removed by hand-cutting.

Loss and alteration of woodland habitat are the most serious threats facing the Houston toad. Extensive clearing of native vegetation near breeding ponds and on the uplands adjacent to these ponds reduces the quality of breeding, foraging, sheltering, and resting habitat and increases the chances of predation and competition (including the spread and proliferation of fire ants). Minimizing the loss and fragmentation of woodland habitat would also benefit bald eagles that occur in the Lost Pines area.

5. Outside the approximately 0.5 acre development area, the Permittee shall not alter or disturb any wetlands, ponds (including temporary ponds which form in drainage areas), or bogs located on the property.

Alteration of temporary and permanent natural wetlands for urban and agricultural uses eliminates breeding sites. Draining a wetland or converting a temporary wetland to a permanent pond can eventually cause the Houston toad to decline or be eliminated entirely. Many amphibians, like the Houston toad, return to the same breeding site year after year, so eliminating their breeding ponds can prevent breeding from occurring.

6. The Permittee shall control fire ant infestations by limiting soil disturbance, inspecting imported soil and nursery products thoroughly for fire ants and eggs, and by properly disposing of trash. If imported top soil and nursery products are to be used, they must be inspected for the presence of fire ants and their eggs. If fire ants or their eggs are present,

the top soil and/or nursery products shall be treated prior to use, and will only be used within the approximately 0.5-acre development area.

Fire ants tend to benefit from the presence of humans and are known to prey on toadlets (less than 7-10 days old), as well as on the invertebrate community that makes up the toad's food base. Where fire ant infestations occur they undoubtedly impact humans, as well as plant and animal communities, directly and indirectly. One of the best deterrents to fire ants is protection of woodlands, since fire ants prefer open, sunny areas where soils have been disturbed.

7. The Permittee will provide \$1,000.00 (for each single-family residence or other similar structure on approximately 0.5 acres or less) to the National Fish and Wildlife Foundation (NFWF) for the specific purpose of land acquisition and management within Houston toad habitat in Bastrop County. Protection of the Lost Pines forest would also benefit the bald eagle. Funds must be provided prior to or at the time of permit issuance. The Service will forward the check or money order to:

National Fish and Wildlife Foundation
1120 Connecticut Ave., N.W., Suite 900
Washington, D.C. 20036

The following information must also be on the check or money order: the Permittee's full permit number TE-025965-1-X (low) [Permittee's permit number will be inserted at the X]) and REF# 98-245.

Currently, large parcels of raw land are estimated at \$2,000/acre. Thus, each remittance of \$1,000.00 by participating landowners will aid in the acquisition and permanent protection and management of about 0.5 acres of Lost Pines forest in Bastrop County. All funds that are contributed to the NFWF will be used solely for the acquisition, preservation, and management of Houston toad habitat in Bastrop County. NFWF holds all monies generated by mitigation (or required under Section 7) in the Houston Toad Conservation Fund until funds accrue to a point that they can be used to purchase lands identified by the Service as being important for preservation of the Houston toad in Bastrop County. Protection of the Lost Pines forest would also benefit the bald eagle. The Service is continuing to seek additional sources of federal grants and other sources of funding to match funds held within the Houston Toad Conservation Fund. The Service will be responsible for working with NFWF and Bastrop County to direct funding for land acquisition and management.

8. The area where soil and/or vegetation will be disturbed will be minimized to the greatest extent possible, paying close attention to whether Houston toads are present or not. If a Houston toad is seen during excavation, all work must cease and the Permittee must contact the Service immediately to discuss the matter, and coordinate further activities in that area.

9. The current "No Surprises" policy of the Service provides that additional mitigation requirements for land, water, or financial obligations shall not be required of any Permittee or his/her successors or assigns beyond the level of mitigation required in this HCP if fully and completely complied with and implemented during the five-year period of this permit. With respect to the permit issued under this HCP and its other supporting documents, impacts to the Houston toad and bald eagle are adequately addressed.
10. Each Permittee will inform the Service in writing upon completion of construction, noting the exact permit number (TE-025965-1-X (low)[Permittee's permit number will be inserted at the X]) to which completion of construction applies. Site development and construction activities shall occur before permit expiration. The written notification will be submitted by October 1 of the year in which construction is completed to the U.S. Fish and Wildlife Service Office, 10711 Burnet Road, Suite 200, Austin, Texas 78758 and to the U.S. Fish and Wildlife Service, Ecological Services, P.O. Box 1306, Room 4102, Albuquerque, New Mexico 87103.
11. The Permittee shall record the permit and appropriate attachments with the County Clerk, Bastrop County, Texas, prior to the beginning of development-related activities on the Permittee's property and provide a copy of this action to the U.S. Fish and Wildlife Service, Austin Office within 30 days.
12. Upon locating a dead, injured, or sick Houston toad, bald eagle, or any other endangered or threatened species, each Permittee is required to contact the Service's Law Enforcement Office in Austin, Texas, (512) 490-0948 or in San Antonio, Texas, (210) 681-8419, for care and disposition instructions. Extreme care should be taken in handling sick or injured individuals to ensure effective and proper treatment. Care should also be taken in handling dead specimens to preserve biological materials in the best possible state for analysis of cause of death. In conjunction with the care of sick or injured endangered/threatened species, or preservation of biological materials from a dead specimen, each Permittee and his/her contractor/subcontractor has the responsibility to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.
13. Conditions of each permit issued under this HCP shall be binding on, and for the benefit of, each Permittee and his/her respective successors and assigns. If a permit requires an amendment because of change of ownership, the Service will process that amendment without the requirement of a Permittee preparing any new documents or providing any mitigation over and above that required in the original permit. The construction activities proposed, or in progress, under an original permit may not be interrupted provided the required special conditions of an issued permit are being followed.
14. If, during the tenure of a permit issued under this HCP, the project design and/or the extent of the habitat impact described in the HCP is altered, such that there may be an increase in the anticipated take of the Houston toad or bald eagle, that Permittee is required to contact the Service and obtain authorization and/or amendment of the permit before commencing any construction or other activities that might result in take beyond that described in the EA/HCP for the Houston toad and bald eagle.

15. The authorization granted by each permit will be subject to full and complete compliance. Each Permittee will be responsible for implementation of the EA/HCP for the Houston toad, bald eagle, and all specific conditions contained in this permit. Acceptance of a permit serves as evidence that each Permittee understands and agrees to abide by the terms of the permit and all applicable Sections of Title 50 of the Code of Federal Regulations Parts 13 and 17 pertinent to issued permits.

Terms and Conditions for the 42 Subdivisions in Medium Quality Habitat (Table 2)

The following measures are proposed to minimize and mitigate for impacts to the Houston toad and bald eagle for the construction and occupation of each single-family residence or other similar structure, associated buildings, and infrastructure on the remaining undeveloped lots within the forty-two (42) medium quality habitat subdivisions to which this EA/HCP applies in Bastrop County:

1. Each single-family residence or other similar structure, associated buildings, and infrastructure will cover approximately 0.5 acres or less of the total property. This 0.5-acre delineation does not include the driveway, provided it is less than 16 feet wide. If the driveway is greater than 16 feet wide, it will be considered part of the 0.5-acre development area. The remainder of the property shall be maintained in its natural vegetational state. Clearing during pre-construction and construction of any single-family residence or other similar structure will be limited to the 0.5-acre development area.

Woodland habitat is essential to provide cover, food, and shelter for the Houston toad. Minimizing habitat loss and fragmentation within the subdivisions and providing connectivity and dispersal corridors between large, contiguous blocks of woodland habitat are important to the toad's continued survival. In east Texas, bald eagles are also known to roost and forage in pine woodlands. Bald eagles are a rare to uncommon winter resident in the Lost Pines forest.

2. Use of construction equipment will be limited to the approximately 0.5-acre development area, and erosion control measures will be implemented as necessary to prevent soil erosion and run-off from the property.

Minimizing the area impacted during construction reduces the level of destruction and fragmentation within Houston toad and bald eagle habitat, as well as within the Lost Pines ecosystem. Use of erosion control measures aids in the protection of water quality within the area surrounding the development area.

3. The Permittee shall avoid or minimize use of herbicides and pesticides. If these products are used at all, they must be applied in full compliance with label guidelines for dilution and application. If the Permittee determines that an insecticide or herbicide treatment must be used, he/she must avoid contamination of temporary ponds and other natural wetlands or bogs by limiting use of chemicals near them and by disposing of rinse water and empty containers in strict accordance with label directions.

Amphibians are very sensitive to many contaminants, including pesticides and other organic compounds. These chemicals may affect the toad directly or indirectly by affecting the toad through skin absorption, ingestion, inhalation, or by lowering the abundance and diversity of its food supply. Certain pesticides are also a known threat to bald eagles.

4. No logging, cutting of trees, or removal of vegetation shall be done outside of the approximately 0.5-acre development area, with the exception of dead, dying, or diseased trees or tree limbs which may be removed if the Permittee desires. Also, if the Permittee desires, common understory plants including yaupon, mesquite, and eastern red cedar found on the property may be removed by hand-cutting.

Loss and alteration of woodland habitat are the most serious threats facing the Houston toad. Extensive clearing of native vegetation near breeding ponds and on the uplands adjacent to these ponds reduces the quality of breeding, foraging, sheltering, and resting habitat and increases the chances of predation and competition (including the spread and proliferation of fire ants). Minimizing the loss and fragmentation of woodland habitat would also benefit the bald eagle.

5. Outside the approximately 0.5 acre development area, the Permittee shall not alter or disturb any wetlands, ponds (including temporary ponds which form in drainage areas), or bogs located on the property.

Alteration of temporary and permanent natural wetlands for urban and agricultural uses eliminates breeding sites. Draining a wetland or converting a temporary wetland to a permanent pond can eventually cause the Houston toad to decline or be eliminated entirely. Many amphibians, like the Houston toad, return to the same breeding site year after year, so eliminating their breeding ponds can prevent breeding from occurring.

6. The Permittee shall control fire ant infestations by limiting soil disturbance, inspecting imported soil and nursery products thoroughly for fire ants and eggs, and by properly disposing of trash. If imported top soil and nursery products are to be used, they must be inspected for the presence of fire ants and their eggs. If fire ants or their eggs are present, the top soil and/or nursery products shall be treated prior to use, and will only be used within the approximately 0.5-acre development area.

Fire ants tend to benefit from the presence of humans and are known to prey on toadlets (less than 7-10 days old), as well as on the invertebrate community that makes up the toad's food base. Where fire ant infestations occur they undoubtedly impact humans, as well as plant and animal communities, directly and indirectly. One of the best deterrents to fire ants is protection of woodlands, since fire ants prefer open, sunny areas where soils have been disturbed.

7. The Permittee will provide \$1,500.00 (for each single-family residence or other similar structure on approximately 0.5 acres or less) to the National Fish and Wildlife Foundation

(NFWF) for the specific purpose of land acquisition and management within Houston toad habitat in Bastrop County. Protection of the Lost Pines forest would also benefit the bald eagle. Funds must be provided prior to or at the time of permit issuance. The Service will forward the check or money order to:

National Fish and Wildlife Foundation
1120 Connecticut Ave., N.W., Suite 900
Washington, D.C. 20036

The following information must also be on the check or money order: the Permittee's full permit number (TE-025997-1-X (medium) [Permittee's permit number will be inserted at the X]) and REF# 98-245.

Currently, large parcels of raw land are estimated at \$2,000/acre. Thus, each remittance of \$1,500.00 by participating landowners will aid in the acquisition and permanent protection and management of about 0.75 acres of Lost Pines forest in Bastrop County. All funds that are contributed to the NFWF will be used solely for the acquisition, preservation, and management of Houston toad habitat in Bastrop County. NFWF holds all monies generated by mitigation (or required under Section 7) in the Houston Toad Conservation Fund until funds accrue to a point that they can be used to purchase lands identified by the Service as being important for preservation of the Houston toad in Bastrop County. Protection of the Lost Pines forest would also benefit the bald eagle. The Service is continuing to seek additional sources of federal grants and other sources of funding to match funds held within the Houston Toad Conservation Fund. The Service will be responsible for working with NFWF and Bastrop County to direct funding for land acquisition and management.

8. The area where soil and/or vegetation will be disturbed will be minimized to the greatest extent possible, paying close attention to whether Houston toads are present or not. If a Houston toad is seen during excavation, all work must cease and the Permittee must contact the Service immediately to discuss the matter and coordinate further activities in that area.
9. The current "No Surprises" policy of the Service provides that additional mitigation requirements for land, water, or financial obligations shall not be required of any Permittee or his/her successors or assigns beyond the level of mitigation required in this HCP if fully and completely complied with and implemented during the five-year period of this permit. With respect to the permit issued under this HCP and its other supporting documents, impacts to the Houston toad and bald eagle are adequately addressed.
10. Each Permittee will inform the Service in writing upon completion of construction, noting the exact permit number (TE-025997-1-X (medium) [Permittee's permit number will be inserted at the X]) to which completion of construction applies. Site development and construction activities shall occur before permit expiration. The written notification will be submitted by October 1 of the year in which construction is completed to the U.S. Fish and Wildlife Service Office, 10711 Burnet Road, Suite 200, Austin, Texas

78758 and to the U.S. Fish and Wildlife Service, Ecological Services, P.O. Box 1306, Room 4102, Albuquerque, New Mexico 87103.

11. The Permittee shall record the permit and appropriate attachments with the County Clerk, Bastrop County, Texas, prior to the beginning of development-related activities on the Permittee's property and provide a copy of this action to the U.S. Fish and Wildlife Service, Austin Office within 30 days.
12. Upon locating a dead, injured, or sick Houston toad, bald eagle, or any other endangered or threatened species, each Permittee is required to contact the Service's Law Enforcement Office in Austin, Texas, (512) 490-0948 or in San Antonio, Texas, (210) 681-8419, for care and disposition instructions. Extreme care should be taken in handling sick or injured individuals to ensure effective and proper treatment. Care should also be taken in handling dead specimens to preserve biological materials in the best possible state for analysis of cause of death. In conjunction with the care of sick or injured endangered/threatened species, or preservation of biological materials from a dead specimen, each Permittee and his/her contractor/subcontractor has the responsibility to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.
13. Conditions of each permit issued under this HCP shall be binding on, and for the benefit of, each Permittee and his/her respective successors and assigns. If a permit requires an amendment because of change of ownership, the Service will process that amendment without the requirement of a Permittee preparing any new documents or providing any mitigation over and above that required in the original permit. The construction activities proposed or in progress under an original permit may not be interrupted provided the required special conditions of an issued permit are being followed.
14. If, during the tenure of a permit issued under this HCP, the project design and/or the extent of the habitat impact described in the HCP is altered, such that there may be an increase in the anticipated take of the Houston toad or bald eagle, that Permittee is required to contact the Service and obtain authorization and/or amendment of the permit before commencing any construction or other activities that might result in take beyond that described in the EA/HCP for the Houston toad and bald eagle.
15. The authorization granted by each permit will be subject to full and complete compliance. Each Permittee will be responsible for implementation of the EA/HCP for the Houston toad, bald eagle, and all specific conditions contained in this permit. Acceptance of a permit serves as evidence that each Permittee understands and agrees to abide by the terms of the permit and all applicable Sections of Title 50 of the Code of Federal Regulations Parts 13 and 17 pertinent to issued permits.

Recommendations for Subdivisions within Both Medium and Low Quality Habitat
(Tables 1 and 2)

The following are recommendations the Service anticipates will further reduce possible impacts to the Houston toad and its habitat within the 46 subdivisions as well as possible impacts to the bald eagle. These recommendations are discretionary, but the Service strongly urges each landowner consider instituting these measures.

1. Use safe, effective alternatives to chemicals, such as integrated pest management, organic gardening, and/or xeriscaping.
2. Keep leaf and pine needle raking to a minimum and confined to the 0.5-acre area of the single-family residence or other similar structure. Avoid removing fallen trees and other woody debris outside of the development area.

Leaf litter and decaying woody debris support the toad's food supply and provide important cover for the toad.

3. Red-imported fire ant mounds should be treated with boiling water or commercial fire ant bait. Care should be taken to treat only red-imported fire ants and not native ant species, which are important to help combat fire ants. Boiling water is one of the most effective treatments for fire ants. If this form of treatment is used, one to four gallons of boiling or near-boiling water should be poured directly onto the mounds with small amounts (1-2 tsps) of detergent added to the boiling water. If baits (such as Amdro or Logic) are used, the following protocol should be used to increase effectiveness and avoid impacting non-target species: (1) place baits out in mid-morning, when fire ants are most likely to be actively foraging, (2) set out baits when ground is warm and dry and no rain is predicted for that day, and (3) place baits near but not directly on the mound. No more than 0.75 pounds of bait per 0.5 acres should be used, and baits should not be used if the presence of red-imported fire ants has not been verified within the previous year. Baits should not be broadcast but placed near existing fire ant mounds to avoid impacts to native ants and other invertebrate species.

6.1 AMENDMENT PROCEDURE

It is necessary to establish a procedure whereby each of these endangered species permits can be amended. However, it is extremely important that the cumulative effect of amendments will not jeopardize any endangered species or other rare species. Amendments must be evaluated based on their effect on the habitat as a whole. The Service must be consulted on all proposed amendments. The types of proposed amendments and the applicable amendment procedures follow.

6.2 AMENDMENTS TO SINGLE-FAMILY RESIDENCE (OR OTHER SIMILAR STRUCTURE) DEVELOPMENT PLANS

It is acknowledged that upon the written request of any participating landowner, the local agency having land use regulatory jurisdiction is authorized, in accordance with applicable law, to approve amendments to development plans, as long as the subject lot/property and its development plans do not encroach on any endangered species habitat that is not presently contemplated to be taken as a consequence of the development, does not include a development envelope greater than 0.5 acres, and which does not alter the conditions set forth in this HCP.

6.3 MINOR AMENDMENTS TO THE HCP

Minor amendments involve routine administrative revisions or changes to the operation and management program and which do not diminish the level or means of mitigation. Such minor amendments do not alter the terms of the Section 10(a)(1)(B) permit. Upon the written request of a participating landowner, the Service is authorized to approve minor amendments to this HCP, if the amendment does not conflict with the primary purpose of this HCP as stated in Section 2.0.

6.4 ALL OTHER AMENDMENTS

All other amendments will be considered an amendment to the Section 10(a)(1)(B) permit, subject to any other procedural requirements of federal law or regulation that may be applicable to amendment of such a permit.

7.0 DURATION

Endangered species permits may be issued under this 46 Subdivisions HCP for either: (1) a period of 5 years from date of issuance of the first permit number and first signed Implementing Agreement under this EA/HCP; or, (2) until complete build-out of the 46 subdivisions occurs; or, (3) until a Bastrop area HCP for Bastrop County has been approved and permitted, whichever comes first. If the five-year period comes first, the Service will review the outcome of the HCP to determine if it should be terminated, extended, or modified. The Service encourages the incorporation of this HCP into a Bastrop area HCP, which may occur at any time. If the Service determines that it is prudent to extend or modify the HCP, or a Bastrop area HCP is approved and permitted, additional opportunities for public review and comment will be provided.

Permits issued to individual landowners under the 46 Subdivision EA/HCP, permit numbers TE-025965-1-X (low) or TE-025997-1-X (medium), will be valid for a period of five years from the date their permit is issued.

8.0 COORDINATION AND CONSULTATION

The following have been coordinated with or consulted during the process of addressing the EA/HCP for construction of single-family residences or other similar structures in the 46 subdivisions to which this EA/HCP applies in Bastrop County, Texas: U.S. Fish and Wildlife Service; Bastrop County; and, Individual Houston Toad HCP Incidental Take Permit Holders in Bastrop County.

Publication of the notice of availability of the Revised Draft Environmental Assessment/Habitat Conservation Plan was published in the *Federal Register* on April 24, 2001, for a public comment period of 60 days. All concerned citizens and entities who requested copies for review and written public comment were provided them.

Reviewed and Approved

Regional Director, Southwest Region

Date

9.0 REFERENCES

- Andren, H. 1995. Effects of landscape composition on predation rates at habitat edges. In: Mosaic Landscapes and Ecological Processes. L. Hansson, L. Fahrig and G. Merriam, eds. Chapman and Hall, London.
- Barnes, V. E. 1974. Geologic Atlas of Texas - Austin Sheet. University of Texas at Austin, Bureau of Economic Geology.
- Bart, H. and M. Taylor. 1999. Systematic review of subgenus *Fuscatelum* of *Etheostoma* with description of a new species from the upper Black Warrior River system, Alabama. *Tulane Stud. Zool. Bot.* 31(1):23-50.
- Bastrop Chamber of Commerce. 1999. (Available on the Internet).
<http://www.rtis.com/reg/bastrop/statepk.htm>
- Bishop, C. and K. Petit (eds). 1992. Declines in Canadian amphibian populations: designing a national monitoring strategy. Occasional paper number 76. Canadian Wildlife Service. Ottawa, Ontario.
- Blaustein, A.R., D.G. Hokit, R.K. O'Hara, and R.A. Holt. 1994. Pathogenic fungus contributes to amphibian losses in the Pacific Northwest. *Biological Conservation* 67: 251-254.
- Brown, L. E. 1971. Natural hybridization and trend toward extinction in some relict Texas toad populations. *Southwest Nat.* 16(2):185-199.
- Burke, D. M. and E. Nol. 1998. Influence of food abundance, nest-site habitat, and forest fragmentation on breeding ovenbirds. *The Auk* 115(1): 96-104.
- Campbell, L. 1995. Endangered and threatened animals of Texas: their life history and management. Resource Protection Division, Endangered Resources Branch, Texas Parks and Wildlife Department. Austin, Texas.
- Christein, D. and D. Taylor. 1978. Population dynamics in breeding aggregations of the American toad (*Bufo americanus*) (Amphibia, Anura, Bufonidae). *Journal of Herpetology* 12(1):17-24.
- Demaynadier, P. and M. Hunter. 1998. Effects of silvicultural edges on the distribution and abundance of amphibians in Maine. *Conservation Biology* 12(2):340-352.
- Denton, J., S. Hitchings, T. Beebee, and A. Gent. 1997. A recovery program for the natterjack toad (*Bufo calamita*) in Britain. *Conservation Biology* 11(6):1329-1338.
- Diamond, J.M. 1975. The Island Dilemma: Lessons of Modern Biogeographic Studies for the Design of Natural Reserves. *Biological Conservation* 7: 129-146.

- Dixon, J.R. 1990. Final contract report: Houston toad (*Bufo houstonensis*) Highway 21 right of way survey. Texas A&M University. College Station, Texas.
- Dixon, J.R. 1983. Survey of the Houston toad at the Caldwell, Texas, site. Final report to the U.S. Fish and Wildlife Service under Contract No. 20181-0352. College Station, Texas.
- Dixon, J.R., N.O. Dronen, J.C. Godwin, and M.A. Simmons. 1990. The amphibians, reptiles, and mammals of Bastrop and Buescher State Parks: with emphasis on the Houston toad (*Bufo houstonensis*) and the short-tailed shrew (*Blarina* sp.). Prepared for Texas Parks and Wildlife Department. Austin, Texas.
- Didham, R. 1998. Altered leaf-litter decomposition rates in tropical forest fragments. *Oecologia* 116: 397-406.
- Dodd, C. and B. Cade. 1998. Movement patterns and the conservation of amphibians breeding in small, temporary wetlands. *Conservation Biology* 12(2):331-339.
- Dutton, A. 1999. Groundwater Availability in the Carrizo-Wilcox Aquifer in Central Texas - Numerical Simulations of 2000 Through 2050 Withdrawal Projections. Bureau of Economic Geology. Austin, Texas.
- Eber, S. and R. Brandl. 1996. Metapopulation dynamics of the tephritid fly *Urophora cardui*: an evaluation of incidence-function model assumptions with field data. *Journal of Animal Ecology* 65: 621-630.
- Fahrig, L. and G. Merriam. 1994. Conservation of Fragmented Populations. *Conservation Biology* 8: 50-59.
- Fahrig, L. and J. Pedlar, S. Pope, P. Taylor, and J. Wegner. 1995. Effect of road traffic on amphibian density. *Biological Conservation* 73:177-182.
- Findlay, C. and J. Houlahan. 1997. Anthropogenic correlates of species richness in southeastern Ontario wetlands. *Conservation Biology* 11(4):1000-1009.
- Follet, C. R. 1970. Groundwater resources of Bastrop County, Texas. Texas Water Development Board Report 109.
- Freed, P.S. and K. Neitman. 1988. Notes on predation on the endangered Houston toad, *Bufo houstonensis*. *The Texas Journal of Science* 40(4): 454-455.
- Freeman, B. 1996. Birds of Bastrop and Buescher State Parks, including Lake Bastrop: a field checklist. Natural Resource Program, Texas Parks and Wildlife Department. Austin, Texas.
- Gibbs, J. 1998. Amphibian movements in response to forest edges, roads, and streambeds in southern New England. *Journal of Wildlife Management* 62(2):584-589.

- Harfenist, A., T. Power, K. Clark, and D. Peakall. 1989. A review and evaluation of the amphibian toxicological literature. Technical Report No. 61. Canadian Wildlife Service. Ottawa, Canada.
- Hazelwood, E. 1970. Frog pond contaminated. *Brit. J. Herpetol.* 4:177-185.
- Harris, L. 1984. *The Fragmented Forest: Island Biogeography Theory and the Preservation of Biotic Diversity*. University of Chicago Press. Chicago, Illinois.
- Hecnar, S. and R. M'Closkey. 1997. The effects of predatory fish on amphibian species richness and distribution. *Biological Conservation* 79:123-131.
- Hill, J.K., C.D. Thomas, and O.T. Lewis. 1996. Effects of habitat patch size and isolation on dispersal by *Hesperia comma* butterflies: implications for metapopulation structure. *Journal of Animal Ecology* 65: 725-735.
- Hillis, D.M., A.M. Hillis, and R.F. Martin. 1984. Reproductive ecology and hybridization of the endangered Houston toad (*Bufo houstonensis*). *Journal of Herpetology*. 18(1):56-71.
- Holmes, E.E., M.A. Lewis, J.E. Banks, and R.R. Veit. 1994. Partial differential equations in ecology: spatial interactions and population dynamics. *Ecology* 75: 17-29.
- Jiquan, Chen, J. Franklin, and T.A. Spies. 1992. Vegetation responses to edge environments in old growth Douglas-fir forests. *Ecological Applications*. 2: 387-396.
- Kapos, V., G. Ganade, E. Matusui, and R.L. Victoria. 1993. Carbon 13 isotope as an indicator of edge effects in tropical rainforest reserves. *Journal of Ecology* 81: 425-432.
- Kattan, G.H., H. Alvarez-Lopez, and M. Giraldo. 1994. Forest fragmentation and bird extinctions: San Antonio eighty years later. *Conservation Biology* 8: 138-146.
- Kelly, P.A. and J.T. Rotenberry. 1993. Buffer zones for ecological reserves in California: replacing the guesswork with science. In: *Interface Between Ecology and Land Development in California*. J.E. Keeley ed. Southern California Academy of Sciences, Los Angeles.
- Kier, R. and R. Larkin. 1998. Hydrogeology of the Carrizo-Wilcox aquifer system, Bastrop, Caldwell, Fayette, Lee, Travis, and Williamson counties. Preliminary report prepared for Aqua Water Supply Corporation. Robert S. Kier Consulting. Austin, Texas.
- Kindvall, O. 1999. Dispersal in a metapopulation of the bush cricket, *Metrioptera bicolor* (Orthoptera: Tettigoniidae). *Journal of Animal Ecology* 68: 172-185.
- Knutson, M., J. Sauer, D. Olsen, M. Mossman, L. Hemesath, and M. Lannoo. 1999. Effects of landscape composition and wetland fragmentation on frog and toad abundance and species richness in Iowa and Wisconsin, U.S.A. *Conservation Biology* 13(6):1437-1446.

- Kotanen, P. M., J. Bergelson, and D. L. Hazlett. 1998. Habitats of native and exotic plants in Colorado shortgrass steppe: a comparative approach. *Canadian Journal of Botany* 76: 664-672.
- Kozlov, M. 1996. Patterns of forest insect distribution within a large city: microlepidoptera in St. Petersburg, Russia. *Journal of Biogeography* 23: 95-103.
- Kruse, K.C. and B.M. Stone. 1984. Largemouth bass (*Micropterus salmoides*) learn to avoid feeding on toad (*Bufo*) tadpoles. *Anim. Behav* 32: 1035-1039.
- Kupferberg, S. 1997. Bullfrog (*Rana catesbeiana*) invasion of a California river: the role of larval competition. *Ecology* 78(6):1736-1751.
- Kuussaari, M., M. Nieminen, and I. Hanski. 1996. An experimental study of migration in the Glanville fritillary butterfly *Melitaea cinxia*. *Journal of Animal Ecology* 65: 791-801.
- Laan, R. and B. Verboom. 1990. Effects of pool size and isolation on amphibian communities. *Biological Conservation* 54:251-262.
- Landreth, H. and D. Ferguson. 1968. The sum compass of Fowler's toad, *Bufo woodhousei fowleri*. *Behavior* 30(1):27-43.
- Laurance, W.F. 1991. Edge effects in tropical forest fragments: application of a model for the design of nature reserves. *Biological Conservation* 57: 205-219.
- Laurance, W.F. and E. Yensen. 1991. Predicting the impacts of edge effects in fragmented habitats. *Biological Conservation* 55: 77-92.
- Lovejoy, T.E., R.O. Bierregaard, A.B. Rylands, J.R. Malcolm, C.E. Quintela, L.H. Harper, K.S. Brown, A.H. Powell, G.V.N. Powell, H.O.R Schubert, and M.J. Hays. 1986. Edge and other effects of isolation on Amazon forest fragments. In: *Conservation Biology: The Science and Scarcity of Diversity*. M.E. Soule, ed. Sunderland, Massachusetts.
- Mader, H.J. 1984. Animal habitat isolation by roads and agricultural fields. *Biological Conservation* 29: 81-96.
- Mader, H.J., C. Schell, and P. Kornacker. 1990. Linear barriers to arthropod movements in the landscape. *Biological Conservation* 54: 209-222.
- May, R.M. 1975. Island biogeography and the design of wildlife preserves. *Nature* 254:177-178.
- McBryde, J.B. 1933. The vegetation and habitat factors of the Carrizo Sands. *Ecol. Mono.* 3(2):247-297.

- Meiners, S. and P. Steward. 1999. Changes in community and population responses across a forest to field gradient. *Ecography* 22: 261-267.
- Pechmann, J and H. Wilbur. 1994. Putting declining amphibian populations in perspective: Natural fluctuations and human impacts. *Herpetologica* 50(1):65-84.
- Porter, S.D., A. Bhatkar, R. Mulder, S.B. Vinson, and D.J. Clair. 1991. Distribution and density of polygyne fire ants (Hymenoptera: Formicidae) in Texas. *Journal of Economic Entomology* 84: 866-874.
- Porter, S.D. and D.A. Savignano. 1990. Invasion of polygyne fire ants decimates native ants and disrupts arthropod community. *Ecology* 71: 2095-2106.
- Porter, S.D., B. Van Eimeren, and L.E. Gilbert. 1988. Invasion of red-imported fire ants (Hymenoptera: Formicidae): Microgeography of competitive replacement. *Annals of the Entomological Society of America* 81: 913-918.
- Price, A. 1990. Status of the Houston toad (*Bufo houstonensis*) along State Highway 21, Bastrop County, Texas. Submitted to the Texas Department of Highways and Public Transportation in fulfillment of Interagency Contract (90-91) 0860 330-0568. Texas Parks and Wildlife Department. Austin, Texas.
- Price, A. 1992. Houston toad (*Bufo houstonensis*) status survey. Final report: Project No. E-1-4, Job No. 8. Funded by the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department under Section 6 of the Endangered Species Act. Austin, Texas.
- Ramos, M. (ed). 1997. 1998-1999 Texas Almanac. Prepared by the Dallas Morning News. Texas A-M Press Consortium. College Station, Texas.
- Ranny, J.W., M.C. Bruner, and J.B. Levenson. 1981. The importance of edge in the structure and dynamics of forest islands. In: *Forest Island Dynamics in Man-Dominated Landscapes*. R.L. Burgess and D.M. Sharpe, eds. Springer Verlag, New York.
- Reed, R., J. Johnson-Barnard, and W.L. Baker. 1996. Fragmentation of a forested rocky mountain landscape, 1950-1993. *Biological Conservation* 75: 267-277.
- Reh, W. and A. Seitz. 1990. The influence of land use on the genetic structure of populations of the common frog *Rana temporaria*. *Biological Conservation* 54:239-249.
- Rudolph, D.C. and J. G. Dickson. 1990. Streamside zone width and amphibian and reptile abundance. *The Southwestern Naturalist* 35(4):472-476.
- Saunders, D.A., R.J. Hobbs, and C.R. Margules. 1990. Biological consequences of ecosystem fragmentation: a review. *Conservation Biology* 5: 18-32.

- Semlitsch, R. 1998. Biological delineation of terrestrial buffer zones for pond-breeding salamanders. *Conservation Biology* 12(5):1113-1119.
- Shafer, C. 1997. Terrestrial nature reserve design at the urban/rural interface. In: *Conservation in Highly Fragmented Landscapes*. Schwartz, M. (ed.) Chapman & Hall. New York, New York, 345-378.
- Smith, R.L. 1990. *Ecology and Field Biology*, 4th ed. Harper Collins Publishers, Inc., New York.
- Soil Conservation Service (SCS). 1979. Soil Survey of Bastrop County, Texas. United States Department of Agriculture. Texas Agriculture Experiment Station.
- Soule, M. A. Alberts, and D. Bolger. 1992. The effects of habitat fragmentation on chaparral plants and vertebrates. *Oikos* 63:39-47.
- Stefan, R. and P. Fairweather. 1997. Changes in floristic composition of urban bushland by *Pittosporum undulatum* in northern Sydney, Australia. *Australian Journal of Botany* 45:123-149.
- Suarez, A.V., D.T. Bolger, and T.J. Case. 1998. Effects of fragmentation and invasions on native ant communities in coastal southern California. *Ecology* 79: 2041-2056.
- Texas Department of Transportation (TxDOT). 1993. Houston toad monitoring program: SH 21 from the entrance of Bastrop State Park to FM 1441, Bastrop County, Texas. Austin, Texas.
- Texas State Data Center. 1996. Estimates of the total populations of counties and places in Texas. Dept. of Rural Sociology, Texas Agricultural Experiment Station, Texas A&M University System. College Station, Texas.
- Texas State Data Center. 2000. Estimates of the total populations of counties and places in Texas. Dept. of Rural Sociology, Texas Agricultural Experiment Station, Texas A&M University System. College Station, Texas.
- Tiebout III, H. M. and R. A. Anderson. 1997. A comparison of corridors and intrinsic connectivity to promote dispersal in transient successional landscapes. *Conservation Biology* 11: 620-627.
- Tschinkel, W. 1988. Distribution of two species of fire ants in north Florida in relation to habitat and disturbance. *Ann. Entomol. Soc. Am.* 81:76-81.
- Turner, I. 1996. Species loss in fragments of tropical rain forest: A review of the evidence. *Journal of Applied Ecology* 33: 200-209.

- U.S. Fish and Wildlife Service (USFWS). 1984. Houston Toad Recovery Plan. U.S. Fish and Wildlife Service. Albuquerque, New Mexico.
- U.S. Fish and Wildlife Service (USFWS). 1994. Population and habitat viability assessment: Houston toad (*Bufo houstonensis*). Workshop conducted by IUCN/SSC Conservation Breeding Specialist Group in partial fulfillment of U.S. Fish and Wildlife Service contract #94-172. Apple Valley, Minnesota.
- U.S. Fish and Wildlife Service (USFWS). 1995. Threatened and endangered species of Texas (revised). Austin, Texas.
- U.S. Fish and Wildlife Service (USFWS). 1999. Houston toad recovery team meeting minutes. Austin, Texas.
- U.S. Fish and Wildlife Service (USFWS) and National Fish and Wildlife Foundation (NFWF). 1998. Houston Toad (*Bufo houstonensis*) Conservation Fund: Letter of agreement between U.S. Fish and Wildlife Service and the National Fish and Wildlife Foundation. Austin, Texas.
- U.S. Fish and Wildlife Service (USFWS) and Texas Agricultural Extension Service, Bastrop County, Bastrop Board of Realtors, Bastrop County Environmental Network, Bastrop Economic Development Corporation, Champion International Corporation, City of Bastrop, Lower Colorado River Authority, Broadway Bank, Community Bank of Smithville, Elgin Bank, First National Bank of Bastrop, First State Bank of Smithville in Bastrop, Lost Pines National, Norwest Bank Texas NA, Aqua Water, and Texas Parks and Wildlife Department. 2000. Amended Challenge Cost-Share Agreement No. 1448-20181-98-J609. Austin, Texas.
- Van Gelder, J. 1973. A quantitative approach to mortality resulting from traffic in a population of *Bufo bufo* L. *Oecologia* 13:93-95.
- Vinson, S.B. and A.A. Sorensen. 1986. Imported fire ants: Life history and impact. Texas Department of Agriculture and Texas A&M University.
- Voris, H. K. and J. P. Bacon, Jr. 1966. Differential predation on tadpoles. *Copeia* 1966: 594-598.
- Vos, C.C. and J.P. Chardon. 1998. Effects of habitat fragmentation and road density on the distribution pattern of the moor frog *Rana arvalis*. *Journal of Applied Ecology* 35:44-56.
- Welsh, H. Relictual amphibians and old-growth forests. 1990. *Conservation Biology* 14:309-319.
- Wigley, T. and T. Roberts. 1997. Landscape-level effects of forest management on faunal diversity in bottomland hardwoods. *Forest Ecology and Management* 90: 141-154.

- Wilcove, D., C. McLellan, and A. Dobson. 1986. Habitat fragmentation in the temperate zone. In: Conservation Biology: The Science of Scarcity and Diversity. M.E. Soule, ed. Sinauer Associates, Inc. Sunderland, Massachusetts.
- Yahner, R.H. 1988. Changes in wildlife communities near edges. Conservation Biology 2: 333-339.
- Yanes, M., J. Velasco, and F. Suarez. 1995. Permeability of roads and railways to vertebrates: the importance of culverts. Biological Conservation 71:217-222.
- Yantis, J.H. 1989. Houston toad distribution and habitat status. Performance report, Job No. 76. Texas Parks and Wildlife Department. Austin, Texas.
- Yantis, J.H. 1990. Houston toad distribution and habitat status. Performance report, Job No. 76. Texas Parks and Wildlife Department. Austin, Texas.
- Yantis, J.H. 1991. Houston toad distribution and habitat status. Performance report, Job No. 76. Texas Parks and Wildlife Department. Austin, Texas.
- Yantis, J.H. 1992. Houston toad distribution and habitat status. Performance report, Job No. 76. Texas Parks and Wildlife Department. Austin, Texas.
- Yantis, J.H. 1994. Houston toad comments. December 10, 1994 memorandum from Jim Yantis, Texas Parks and Wildlife Department, to Lisa O'Donnell and Kathy Nemec, U.S. Fish and Wildlife Service. Austin, Texas.